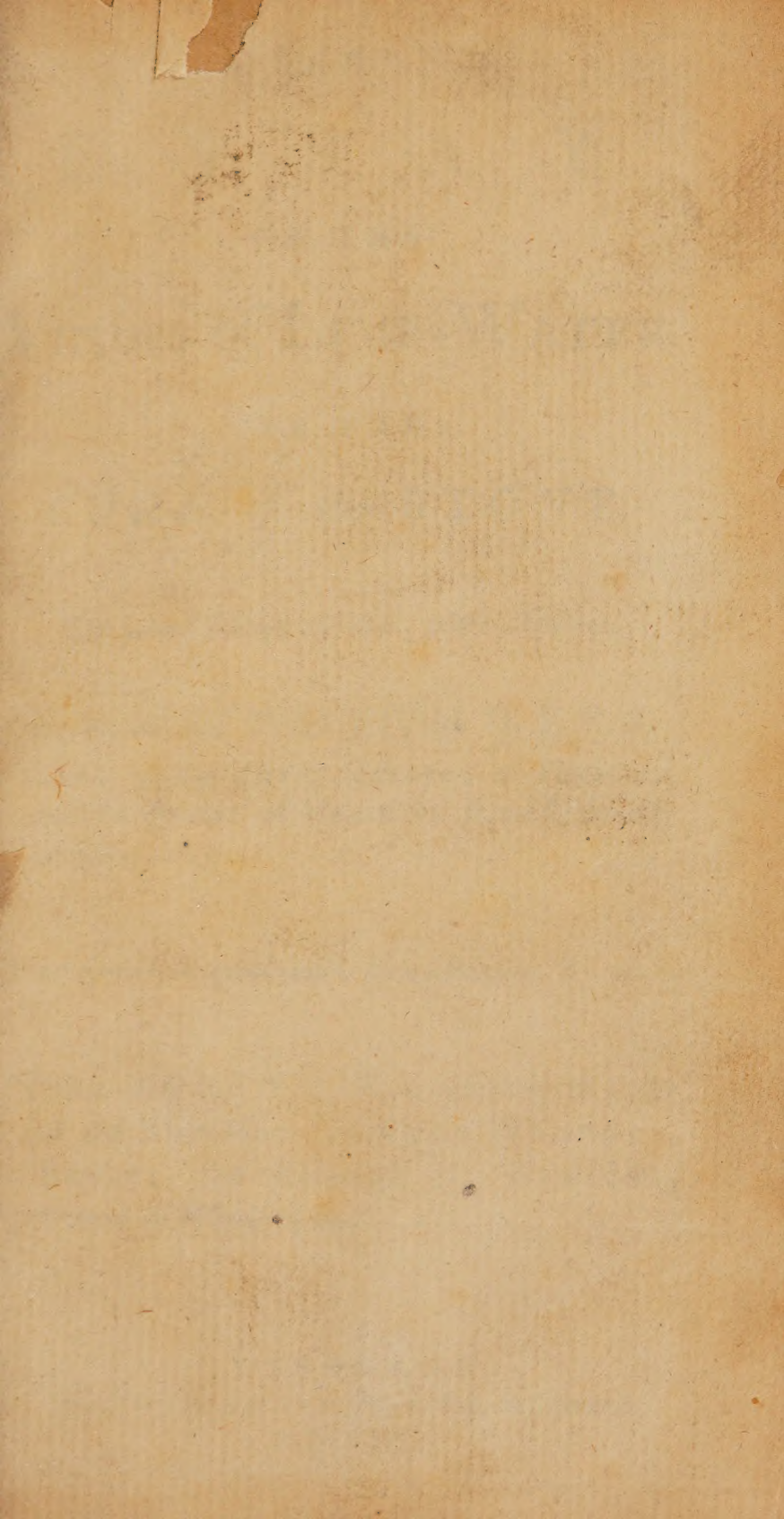




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AN

ESSAY

ON THE

Virtues of LIME-WATER

IN THE

CURE of the STONE.

The Second Edition corrected, with Additions.

By ROBERT WHYTT, M. D. F. R. S.

FELLOW of the ROYAL COLLEGE of Physicians,
and PROFESSOR of MEDICINE in the University
of EDINBURGH.

Non fingendum aut excogitandum, sed inveniendum. BACON.

With an APPENDIX, containing the Cases
of the Right Hon. HORACE WALPOLE,
Esquire; the Reverend Dr. NEWCOME,
Canon of *Windsor*, &c.

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M,DCC,LV.



To
HIS GRACE
ARCHIBALD DUKE of ARGYLL,
Es. Es. Es.

The following Essay
is inscribed,
With the greatest Respect,

By
HIS GRACE'S
Most devoted, and
most obedient
humble Servant,

ROBERT WHYTT.

A D V E R T I S E M E N T.

THE following Essay was first published in the Year 1743, in the Edinburgh Medical Essays, Vol. 5. Part 2, and met with a more favourable Reception from the publick, than the Author, considering its Imperfections, had reason to expect. It is now printed by itself, at the Desire of several of his Friends, who assured him, that, in this way, it might be of more general Use, since many persons, afflicted with the Stone, would chuse to read it, who did not incline to purchase so large a Book as the Medical Essays: And the Author, to render it less unworthy of the Favour of the Publick, has not only corrected, but greatly enlarged it.

*The principal Additions are to be found in Sect. ii. iii. ix. x. xi. xii. and
xiii.*

xiii. and relate chiefly to—the Nature of Quick-lime and its Water ;—the Strength and specifick Gravities of different Lime-waters ;—the particular Action of Lime-water in dissolving the Stone,—and to the Cure of the Stone, not only by swallowing Soap and Lime-water, but by injecting the latter into the Bladder.

The Appendix contains the Case of the Right Honourable HORACE WALPOLE Esq; written by himself, and given me, at his Desire, by the Honourable Mr. Baron Edlin, of his Majesty's Court of Exchequer in Scotland, with liberty to make it publick.

I might have added many other Histories of the good Effects of Lime-water in the Stone, had I not been unwilling to swell this Essay to too great a Bulk : And, indeed, I thought this the less needful, as the Usefulness of this
Remedy

Remedy is, within these few Years, become pretty well known in South as well as North Britain. I have chosen, however, to insert Mr. WALPOLE'S Case preferably to any other, not only because the good effects of the Medicines were here very remarkable, but as it is written by himself, and as the Histories of those, in conspicuous Stations of Life, are wont to make the strongest Impressions upon the Generality of Mankind.

If this Essay, with these Improvements, and as it is now published, shall become of more general Use, and serve to relieve any of his Brethren of Mankind from the racking Pains of the Stone or Gravel, the Author will think his Time and Labour abundantly rewarded.

August 1. 1752.

A D V E R T I S E M E N T
to the second Edition.

IN this Edition the Author has corrected the Errors of the former, and made several Additions. He has added to the Appendix the Cases of the Reverend Dr. NEWCOME and Mr. YOUNG GREEN, which he thought well worth publishing; the latter on account of the uncommon Texture of the Stone, and the former as it shews that Lime-water alone, drunk to the quantity of two English Quarts a-day, communicates to the Urine a Power of dissolving the Stone out of the Bladder, and consequently must act more powerfully upon one lodged there, where the Degree of Heat must increase its dissolving Power; at the same time that this cannot be lessened by the Access of the external Air, which as it soon weakens the lithontriptick Power of Lime-water, must do the same by the Urine impregnated with its Virtues.

November 6. 1754.

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E S S A Y

ESSAY

ON THE

VIRTUES of LIME-WATER

IN THE

CURE of the STONE.

IN the Year 1739, the Parliament of *Great Britain*, in consequence of a Petition presented to the House of Commons by Mrs. *Joanna Stephens*, generously ordered her a Reward of *L. 5000 Sterling*, for publishing her Medicines against the Stone, in case, upon due Trial, their Utility, Efficacy, and dissolving Power, should be attested by the Trustees named for that purpose. But altho' the Virtue of these Medicines is such as may justify the Certificate given of them; yet they are so bulky and nauseous, that some People cannot take them, and many use them with the utmost Reluctance; nay, (as the learned Dr. *Jurin* has well observed), so great is the Resolution required to go thro' a Course of these Medicines,

cines, and so many are the Difficulties attending it, that there have been not a few Instances of such as, after taking them for many Months, without any Benefit, have submitted to be cut, rather than go on any longer with a Medicine so extremely nauseous, and which had greatly increased their Pains, without bringing any thing away (a).

Dr. *Hartley* (b) leaving out the superfluous useless Part of Mrs. *Stephens's* Compositions, has reduced them to two and a half Ounces of Soap, and seven and a half Scruples of Egg-shell Powder, as the mean Dose to be taken every Day. But the Powder is so nauseous, and this Quantity of Soap is so great, that I suspect we shall find few Patients who will continue to take the Medicines thus reformed by him for any considerable Time (c).

After

(a) Dr. *Jurin's* Case, p. 4. and 5.

(b) See his Supplement to the View of the present Evidence.

(c) Dr. *Hartley* has lately, for such as can't take the Soap and Powder in a Liquid, published the following Method of giving them in a solid Form, viz. To take of *Alicant* Soap eight Ounces; powdered Quick-lime a little flaked, one Ounce; Salt of Tartar, or purified Potash, a Dram; and shaving the Soap, and mixing it with the Lime and Salt, to beat all into a soft Mass, with the Help of as much

After reading the ingenious Experiments published (1741) by the Reverend and learned Dr. *Hales*, upon Mrs. *Stephens's* Medicines, I was led to think that Lime-water had as fair a Chance as any thing to dissolve the Stone. For since it there appears, that the Soap owes its Virtues neither to the Potash nor Oil, but wholly to the Quicklime that enters into its Composition; and as Mrs. *Stephens's* Powder which she used long before she gave the Soap in any Quantity (*d*), and which she still lays great Strefs upon, is no other than a Lime; it is very reasonable to expect great Benefit from Lime-water; which has this further Advantage, that by its means the Virtues of a greater Quantity of Lime may be safely conveyed into the Blood; for in Soap the Lime bears so small a Proportion to the other Ingredients, that but a very inconsiderable Quantity.

A. 2.

tity.

much Water as is necessary: Of this Mass, from three to four Ounces are to be taken every Day, made into Rolls a little taper at each End, which are to be laid length-ways on the Tongue, and swallowed with a Mouthful of Water. In this way the Quantity of Soap to be taken daily, is nearly from two Ounces and five Drams, to three Ounces and a half; of Lime-powder, from three Drams to near half an Ounce; and of Salt of Tartar, or purified Potash, from a Scruple to near half a Dram.

(*d*) *Hartley's* Supplement to the present View, p. 1.

tity of it can in this Form be mixed with our Fluids (*e*), and of the Powder (half flaked and greatly weakened by being exposed fixty Days to the open Air) only a few Scruples are exhibited a-day. If this Powder is swallowed without enough of Liquids along with it, it may be of bad Consequence, and, I am afraid, has been the Occasion of great Heat and Uneasiness in many People's Stomachs; and if
it

(*e*) In *England* they make Soap with a Lye of potash and Quick lime, boiled up with Fat and Oil to a proper Consistence; and it is upon the Supposition of *Alicant* Soap being also made in this manner that Dr. *Hales's* Experiments mostly proceed; for having found a Lye of Potash and Quick lime which is of a Nature most intolerably fiery and corrosive, to dissolve the Stone more quickly than any thing except Spirit of Nitre, it was reasonable to expect that Soap, of which this constitutes so considerable a part, should be possessed of a dissolving Virtue likewise. But I have been informed that at *Alicant* in *Valencia*, where the best Soap is made, there is no Quick-lime used in its Composition, but instead of it only Lime-water, which, together with alkaline Salt got from the Ashes of the Herb *Kali*, and with Oil of Olives, is boiled in large Caldrons that hold several Tons, till it acquires a proper Thickness, when they pour it out on a Floor, and, before it hardens, cut it into Bricks. See also *Lymery's Dictionnaire de drogues*, p. 485. *Savon est une composition fait avec l'huile d'olives la plus grossiere, de l'amidon, de l'eau de chaux, & de la lessive tiree de cendres du kali.* *L'amidon*, the Starch, he tells afterwards, is only sometimes added in order to make the Soap whiter and turn sooner thick.

it is sufficiently diluted, especially with White-wine, Cyder, or other acescent Liquors, as Mrs. *Stephens* directs, it can have little other Effect than weak Lime-water. When to all this it is added, that Lime-water is found by Experience to dissolve a Stone out of the Bladder, is it not reasonable to expect, that when taken in large Quantities, and but little weakened by the drinking of other Liquors, the Urine likeways may be so far impregnated with its Virtues, as to acquire a Power of dissolving the Stone?

But as reasoning *à priori*, unsupported by Experience, is not sufficient to ascertain the Virtues of any Medicine, I embraced the first Opportunity that offered to make a Trial of Lime-water; the Effects of which will best appear from the following History.

Mr. *David Millar*, Master of the Grammar-school of *Kirkaldy*, about sixty Years of Age, had, from the Year 1704, been often distressed by Stones passing from the Kidneys to the Bladder. Sometimes he has had severe Fits of Pain once or twice in a Year, and sometimes but once in two or three Years, and these of two, three, or four, and even of eight or fourteen Days Continuance; but always in a few Days after these Fits he voided one or

more Stones till *June* 1740; when, after a painful Fit of Distress and Sicknefs for two Days, the Stone arrived at his Bladder; but though he used his ordinary Means of riding, walking quick, jumping, and drinking plenty of proper Liquors to make it pass, yet all his Endeavours were in vain.

For half a Year after this, he was troubled with frequent Obstructions in making Urine, altho' without any great stimulating Pain, except in voiding the two or three last Drops. Afterwards he thought he found the Stone increase, and become heavier in his Bladder; and from *March* (1741), upon riding or walking a Mile or two, his Urine was always mixed with Blood: Besides, from the Beginning of *January* he had lost all Power of retaining his Urine, being obliged to pass it every eight or ten Minutes, and not without great stimulating Pains; yet sometimes with Intervals of Ease for a Day or two, after sweating and keeping warm.

At first he drank Milk and Water; but in *May* (1741) he began to take Soap, first to the Quantity of half an Ounce every Day, which in the end of *July* he increased to an Ounce, and in the beginning of *September* to near an Ounce and an half; but all this without any
sensible

sensible Relief; his Pain, bloody Urine, and Inability to retain his Urine, still continuing, as before.

In the End of *September* I advised him to drink with the Soap large Quantities of Lime-water, beginning with one, and gradually increasing the Quantity to three *English* Pints a-day, and at the same time to drink no more of any other Liquors than was necessary to quench his Thirst.

Within four or five Days, after he began to drink the Lime-water, he recovered in a great measure the Power of retaining his Urine; and from that Time had less Pain and less bloody Urine, upon using Exercise, than formerly; so that on *November* 13. altho' he walked upwards of six Miles pretty quick, yet he retained his Water for nine or ten Hours together; and as he voided it with little or no Pain, so he found no Blood mixed with it.

November 15. at Night, when going to Bed, and trying to make water, he found a Stone entering the Beginning of the *Urethra*, and obstructing it; which it continued to do all Night. He slept little, and often attempted to pass Urine; but could not, unless a very little, and that Drop after Drop. Next Morning, when he was putting on his Cloaths, finding an Inclination

clination to make water, and endeavouring it with all the Force he could, he voided a smooth Stone, about the Bulk of a common Bean, of a whitish sandy Colour; whereas all those he had passed formerly, were of a brown Colour, and rough. It appeared plainly to be a Part of a larger Stone.

Upon the 17th of *November* he walked upwards of two Miles without any Pain or bloody Urine.

November 18. after making Urine he felt something at the Neck of his Bladder, occasioning a slight obtuse Pain, which he took to be another Stone.

From this till the Beginning of *December* he was very easy, not having been obliged, above three or four times a-day, to make water; which was never mixed with Blood, nor attended with those stimulating Pains he formerly had. Only twice or thrice he found his Urine suddenly stop, when he was voiding it; and once he thought a Stone was entering the Passage, which a little after fell back into the Bladder. When he stumbled, or stept down a Stair, he still felt something heavy that pushed or touched him in the under Part of the Bladder. His Urine during all this Time had a great deal of white Sediment, and some brownish

brownish Flakes among it; but he was so much abroad about his Business, that he could not make any regular Observations upon it.

Upon *Thursday* Night, the 3d of *December*, the Stone which he supposed to have been still in his Bladder entered the Beginning of the *Urethra*; where it stuck till *Monday* Morning following: During which time his Urine was very much obstructed, coming away in Drops, or in a very small Stream, with a good deal of Uneasiness and Pain. From this to the End of *December* he was often in the same Condition; the Stone sticking in the Passage sometimes half a Day, sometimes a whole Day, and a Night, and then falling back into the Bladder; but all these Times he never had any of those piercing stimulating Pains which he was wont to feel, before he used the Lime-water, in passing his Urine, and especially after the last Drops; and now also he was able to retain it half a Day, and then void it without Pain. Immediately after emptying his Bladder, he always sensibly perceived the Weight and Pressure of the Stone, if he but walked a little; but when there was any Quantity of Urine in it, this became less perceptible. He concludes a Letter to me at this time with these Words. *As I have hither-*

to enjoyed a good Degree of Health, so now I am easy beyond Expectation, which makes me think the Stone in a dissolving State, and that its Surface is very much smoothed. I continue using the Soap and Lime-water daily; which last I frequently take to my Meat, instead of other Drink, and I think my Urine tastes a little of it.

On Monday, January 4. at Night he found a Stone had got into the Beginning of the *Urethra*, which in a good measure hindered him from voiding any Urine. However, next Morning, after a good Sleep it came away. It was larger than the one he passed before, and appeared evidently to be a Piece of the same Stone.

For some Days after passing this Stone, he found the *Urethra* very tender, and a little pained; which occasioned his making Urine more frequently than usual. But this soon went off; and he has ever since, to use his own Words, been perfectly free of all Pains and Symptoms of the Gravel, and as easy in that Respect as ever he was in his Life; and upon the whole, concludes, that he received more benefit from the Lime water, than any thing he ever used, and to it chiefly ascribes what has happened above.

As

As Authors have sometimes been accused of framing Histories to support a certain Theory, or raise the Value of some favourite Medicine, I thought it might be proper to add the Gentleman's own Attestation of the Truth of what has been above related.

Kirkaldy, June 1. 1742.

Having read the History of my Case drawn up by Dr. Whytt, I do here, for the Satisfaction of the Publick, declare, that it is in every Particular agreeable to Truth: and that at present I am as perfectly free of all Symptoms of the Gravel as ever I was in my Life.

DA. MILLAR.

Upon this History it is natural to observe,

1. That from the Figure and Shape of the Stone first passed, it evidently appeared to be a Fragment of a larger one, that had lain in the Bladder for about seventeen Months, but then was broken, and in some degree dissolved; and as of this no other Cause can be assigned, but the *Soap and Lime water*, it is but reasonable to ascribe it to their Efficacy. That part of the Stone where it has been broke off, has its Edges so sharp, while every where else it is smooth and rounded, and a
red

red *Nucleus* so plainly appears in the middle of it, that no reasonable Doubt can be had of its being part of a larger Stone. But this is put beyond all Question by the Stone last passed, which tallies pretty exactly with the former, is evidently of the same Texture, and the two together, excepting a small Deficiency at one End, seem to make up a compleat Stone. Whether what is wanting has passed in Fragments unobserved, or has come away quite dissolved in Flakes and white Sediment, is not so certain. Farther, as Mr. *Millar* has had no Stones passing from his Kidneys to his Bladder since *June 1740*; if we deny these Stones to have been one, we must suppose them lodged eighteen Months in the Bladder, without either acquiring a greater Bulk, or ever endeavouring to pass; none of which Suppositions are at all likely.

2. The Surfaces of the Stones shew them to have been in a dissolving State. There are Fibres like Roots which run along them, in some Places plainly broken off, and the hollow Furrows they had made still remaining. And as the *Lime-water* and *Soap* had longer Time to act upon the second Stone, so we find still more evident Signs of Dissolution about it. It has in most places a very rotten
Appearance,

Appearance, and in some is eaten so deep, that one can see several of its concentrick Layers. Further, as Dr. *Hales* has observed, (which will more fully appear in the following Experiments), that the *Calculus* generally turns white in dissolving, the whitish Colour of these Stones makes it probable they were in a dissolving State.

3. It does not appear that the Soap alone had any great Influence in this Case: For although from the End of *July*, till about the 8th of *September*, he took an Ounce every Day, and after that near an Ounce and an half; yet he found no sensible Relief; which probably might be owing to his not taking it in so large Quantities as some others have done (f).

4. It would seem that *Lime water* has a very uncommon Efficacy in easing the Symptoms, and probably dissolving the Stone in the Bladder: For in five Days after Mr. *Millar* began to drink it, he was able to retain his Urine better than he had done for eight or nine Months before, and found the stimulating Pains in making it less, and the Quantity of Blood in it sensibly to diminish; so that

B

upon

(f) The mean Quantity ordered by Mrs. *Stephens* is two and a half Ounces.

upon the 13th of *November*, although he walked six Miles pretty quick, he had none of it, nor has had ever since ; and on the 16th of the same Month (having used it little more than six Weeks) he passed the first Stone. Nor is it at all unreasonable to suppose that *Lime-water* may have a greater Effect in dissolving the Stone than *Soap*, since we find it possesses a greater dissolving Virtue out of the Bladder. See *Experiments below*, Sect. 3. compared with N^o 70.

That the *Lime-water*, from its gentle Astringency and strengthening Quality, should have a more sudden Effect in curing the Incontinency of Urine, than the Pain and Blood that, upon Motion, generally accompanied it, is easily accounted for ; since, as the two last proceeded chiefly from the rough Sides of the Stone grating upon, and tearing the Blood-vessels on the internal Coat of the Bladder, this must in part have continued to happen till the Points were worn off its Surface ; and accordingly we find the first Stone was pretty smooth when he voided it. But, besides this, after the Stone once begins to dissolve, its Surface is either covered with a whitish *Mucus*, or soft rotten Scales or Layers, which are thrown off one after another. *Vid. Exper. below.* •

5. It may not be amiss to take notice that although Mrs *Stephens's* Medicines almost always occasion great Pain and Heat of Urine for some Weeks, or even Months, after first taking them (*g*) ; yet the *Soap*, in the Way Mr. *Millar* took it, gave him no such Uneasiness; and the *Lime water* had so very contrary an Effect, that in a few Days it relieved some of his Complaints, and abated others. As the Pain and Heat of Urine in taking these Medicines seem chiefly owing to the alkaline Salt, which bears so great a Proportion in the Composition of the *Soap*, is it not probable, that it was from his beginning to take the *Soap* in very small Quantities, and gradually increasing the Dose, as well as never taking so much of it as is ordered by Mrs. *Stephens*, that Mr. *Millar* escaped this Complaint ?

Finding his Stomach unable to bear the *Soap* in Decoction, he took it every Morning in Substance, only sliced down ; and found it agree very well with him, excepting that it sometimes gave him a little of the Heartburn. and the *Lime-water* and *Soap* were so far from having any bad Effect upon his Health, that he

B 2

rather

(*g*) See Dr. *Hartley's* View of the present Evidence, &c. and Dr. *Kirkpatrick's* Case, written by himself.

rather found himself easier and lighter, and considerably freer of some kind of Lowness of Spirits he had, before, laboured under.

6. As Mr. *Millar* continued from the Beginning of the Year 1742, when this Paper was first written, to *June* 1751 when he died, perfectly free of all Symptoms of the Stone, without taking Medicines of any kind, so there can be no doubt but that the Stone, which gave him so much Uneasiness, was wholly brought away by the Use of the Lime-water and Soap; for if any Part of it had remained, it must, in so long a Time, have acquired Bulk sufficient to have produced the like uneasy Symptoms, with which he had been formerly afflicted. And here it is worthy of Observation, that Mr. *Millar*, by the Use of these Medicines, was not only cured of the Stone in the Bladder, but rendered, during the Remainder of his Life, almost quite free of nephritick Complaints, to which he had been very subject for many Years before.

By this Success of the *Lime-water*, I was induced to make the following Experiments, with a View to a further Discovery of its Nature and Virtues.

SECTION I.

Experiments with Quick-lime.

MALT SPIRITS poured upon a Piece of fresh calcined Lime-stone, are plentifully absorbed by it, without any sensible Ebullition, (some Air-bubbles excepted, that arise from its Surface); nor is it flaked but after lying a great many Hours in them.

I immersed a Piece of Quick-lime in rectified Spirit of Wine, in a close stopped Bottle, which after eight Days scarcely shewed any Appearance of being flaked.

2. Vinegar is somewhat more plentifully absorbed by Quick-lime than Spirits, with a good many Air-bubbles, and hissing Noise at first, which however soon ceases; and if the Lime is fresh from the Fire, it will scarcely be flaked, unless allowed to continue many Hours in it.

Water, whether cold or hot, poured upon Quick-lime that has lain sometime among Spirits or Vinegar, produces no Ebullition, except a very few Air-bubbles at first; and the Stone that has been in the Vinegar is longest in being flaked.

3. Oil is plentifully imbibed by Quick-lime, without any Ebullition or Heat. If there is any Rent in the Stone, a few Air-bubbles will sometimes rise out of it. When put in boiling Water after this, a good many Bubbles of Oil rise from the Surface of the Stone; and, after several Hours standing, it begins to melt down into a soft, fat, argillaceous Substance.

Hence it seems probable, that Oil, by filling the empty Pores, and sheathing, perhaps, the fiery Particles of Quick-lime, destroys its Efficacy so as to hinder its Ebullition with Water: While, on the other hand, Oil has its Nature so far changed by Lime, that it becomes miscible with Water (*b*).

4. Upon putting a Piece of Quick-lime in Claret Wine, a considerable Ebullition immediately happens; but in twenty four Hours the Stone is scarce dissolved.

A Piece of Quick-lime being put into brisk strong Ale, a good many Air-bubbles immediately

(*b*) *Oleum solum calci miscetur, quando utrumque aquas odit. Plin. histor. natur. Lib. 24. cap. 1.*

Calx aqua accenditur, eademque oleo restinguitur. Id. Lib. 33. cap. 5.

Si oleum rosarum vel liliorum alborum vel lini probe agitur in mortario cum Aquâ calcis, ambo coalescunt in modum butyri. Etmuller. oper. vol. 2. p. 799.

diately arose with some Noise; but this was quickly over. After twenty four Hours one third of the Stone was not flaked.

Small Beer has much the same Effect; only the Ebullition is greater, and lasts longer.

Water whether cold or hot, poured upon a Piece of Quick-lime that has lain some time in Ale or Beer, produces no Ebullition, nor easily dissolves it.

5. The Heat or Cold produced by the Mixture of the above Liquors with powdered Quick-lime, I found to be as follows.

When Quick-lime was mixed with Lamp-spirits, the Thermometer fell, in two or three Minutes, from 54 to 53 Degrees.

With Vinegar it rose, in five Minutes, from 52 to 68 Degrees; after which it began to fall.

With Claret it rose, in six Minutes, from 51 to 56 Degrees.

With strong Ale it rose, in ten Minutes, from 48 to 57 Degrees.

With cold Water it rose, in twenty two Minutes, from 48 to 112 Degrees, and then began to fall (i).

6. Ten

(i) The Quantity of Quick-lime used in this Experiment was very small, otherways the Thermometer would have risen much higher.

6. Ten times its Weight of boiling Water being poured upon fresh burnt Limestone, there immediately arises a great Ebullition, which lasts a considerable Time ; when this is over, the Lime falls to the Bottom, and the clear Water above, being filtrated through brown Paper, is that which I made use of in the following Experiments. The Proportion of 8 to 1 ordered in the *Edinburgh* Dispensatory, seems rather too small, as it affords but very little Water, if the Lime-stone be well burnt, and fresh from the Fire: Nor have I observed any remarkable Difference in the Strength of the Lime-water made with these different Proportions.

Cold Water being added to Quick-lime, soon produces a considerable Heat and Ebullition, and this Water has the same Virtues as the above.

7. If Quick-lime be mixed with fresh Urine, it instantly sends forth a pungent Vapour which strikes the Nostrils in much the same Manner as volatile Ammoniac Salt.

S E C T. II.

Experiments with Lime-water upon Urine.

As the calculous Concretions of the Kidneys and Bladder are generated by the Urine, and owe their Growth, entirely to a constant Apposition of Particles derived from this Fluid, I thought it might be worth while, before making any Experiments on the *Calculus*, to try the Effects of *Lime-water* upon *Urine* and its *Sediment*.

8. If two Ounces of Lime-water be added to an equal Quantity of fresh-made Urine, the Mixture instantly becomes whitish and turbid; and, in a little time, a light white Sediment falls to the Bottom, leaving the Liquor above perfectly pellucid, of a fine light Limon-colour (*k*), without any Scum or Crust on the Sides of the Glass.

9. I let some fresh Urine stand by itself in a Glass about forty eight Hours; in which time it had deposited a redish brown Sediment upon the Bottom of the Glass, with a Crust of the same Nature upon its Sides. I
then

(*k*) This, as well as the Quantity of white Sediment, varies according to the Strength of the Urine.

then decanted off the clear Urine, leaving the Sediment and Cruft alone, and filled up the Glafs with Lime-water : Upon which the Sediment immediately rofe from the Bottom, loft its Colour, and the Mixture became white and turbid ; the Cruft on the Sides of the Glafs quickly difappeared ; and in a fhort time a large light white Sediment fell to the Bottom, which, tho' allowed to ftand thirty Hours, did not in the leaft adhere to, or leave any Cruft upon the Bottom or Sides of the Glafs.

Having poured off what was clear, I added fome White-wine Vinegar to this Sediment ; upon which it immediately difappeared, and the Liquor became pretty clear, not unlike Sherry ; which, however, after fome Hours, let fall a dark-coloured Sediment.

a Hence we fee that Lime-water has not only a Power of hindering the Urine from refolving into thofe Principles which are imagined to give rife to the Stone, but alfo of deftroying and changing their Nature after they are feparated from it ; whence arifes a ftrong Probability, that it may not only hinder the Generation of the Stone in the human Body, but alfo difsolve it after it is formed : Nay, altho' it fhould be allowed that Lime-water

water does in a great degree lose its dissolving Power before it arrives at the Bladder; yet if it shall, by destroying the petrifying Quality in the Urine, hinder any new Accretions to the *Calculus*, this must necessarily in time have its Surface washed down, and worn away, by the Urine continually running along it, and the Coats of the Bladder acting upon it; as we find even the hardest Rocks yield to common Water.

Quid magis est saxo durum? quid mollius unda?
Dura tamen molli saxa cavantur aquâ. Ovid.

But that the dissolving Quality of the Lime is really communicated to the Urine, evidently appears from Experiments made with the Urine of such Patients as have taken Mrs. *Stephens's* Medicines for a considerable time in large Quantities. Thus Mr. *Morand* found, that a pretty hard *Calculus* had lost something of its Weight, and had its Surface corroded, by having daily poured upon it for ten Days the fresh Urine of a Patient who had taken Mrs. *Stephens's* Medicines for upwards of a Month (*m*). And, if I rightly remember, much the same Experiment was tried by Dr. *Kirkpatrick*

(*m*) *Memoires de l'Acad. des sciences.* an. 1740. Edit.

8vo, p. 261. 262.

patrick on his own Urine, and with the same Success (n).

β Do not these Experiments afford us a clear Reason why the Stones which Mr. *Millar* passed after drinking the Lime-water, were of a whitish Colour *, whereas all that he had voided, for thirty Years before, were brownish? And do they not likeways render it probable, that the great Quantity of white Sediment in the Urine of such People as have taken Mrs. *Stephens's* Medicines, has been owing to the Action of the Lime contained in them? For we find Lime-water produce that Sediment in Urine out of the Bladder, and by drinking Lime-water Mr. *Millar's* Urine deposited it in great Abundance. The Quantity of this, however, will be increased by what is daily washed off the Surface of the Stone by the Efficacy of the Medicines.

Does it not likeways appear plain from these Experiments, why Dr. *Jurin's* Urine (o) (especially

(n) See his Case written by himself.

* Agreeable to this, the ingenious Mr. *Hay*, in his Case annexed to *Deformity, an Essay*, tells us, that while he continued to take Soap and Lime-water, he never discharged any red Sand with his Urine; but constantly did it when he omitted the Use of these Medicines, even for a few Days.

(o) *Jurin's* Case, p. 12.

pecially after his largest Dose of *Soap-lees*) was whitish and turbid when he first made it, and afterwards deposited a *calcareous* Sediment, as he calls it ; but which, notwithstanding the Opinion that has hitherto prevailed of its being furnished in a good measure by the Medicines (p), seems to have been owing solely to the Change made by the Lime upon the Sediment of the Urine. And that Lime-water not only changes the Colour of the Urine, but of the Surface of the *Calculus* itself, plainly appeared in a Stone (taken from the Body of *John Greig*, who died *December 1741*, in the Royal Infirmary, of an *Iliac Passion*) which had its external Surface almost entirely white and a little rotten, while within it was of a sandy Colour. Of this no Reason could be assigned, but his having drank Lime-water for eight Days, to the Quantity of about an *English Pint* a-day. And it is observable, that as he left off the Lime-water eight or ten Days before his Death, so in some Places there was a brownish Crust beginning to grow over the white Surface.

10. *April 15*. I put into a Phial a Scruple of Oyster-shell Lime and ten Drams of fresh Urine. Into another, I put the same Quantities of Salt of Tartar and fresh Urine : Both these

C

Mixtures .

(p) Hales's Experim. p. 12.

Mixtures immediately sent forth a Vapour which affected the Nose with a pungent Ammoniacal Smell. Into a third Phial I put equal Parts of fresh Urine and Lime-water, which gave an extremely faint Smell of the same kind. And, into a fourth one, the same fresh Urine alone. Having corked these several Phials, I did not open them till the 16th of *May*, when the Urine with Quick-lime had an extremely offensive Smell, not to be described in Words. The Urine mixed with Lime-water had a disagreeable Smell of the same kind, but not so strong. The Urine with Salt of Tartar smelled like stale Urine, and did not affect the Nose near so disagreeably as the two former. The Urine without any Mixture had a stale Smell, but not so strong as that which was mixed with Salt of Tartar.

Hence it appears that Quick-lime, Lime-water and fixed alkaline Salts not only volatilise the Salts of the Urine, but also corrupt its Oils, altho' Quick-lime and its Water produce this last Effect much more remarkably than the alkaline Salt.

SECT.

SECT. III.

Experiments with Lime-water upon the Calculus.

In the following Experiments I made use of two *Calculi*.

The first, which, for Brevity, I shall denote by *A*, was given me by my ingenious Friend and Collegue Mr. *Monro* Professor of Anatomy in this Place. It was of a close Texture, and very hard, and of a grey sandy Colour.

The second, *B*, was the one which I just now mentioned to have been taken out of *John Greig's* Bladder. It seemed fully as hard as the former, and was capable of receiving a pretty fine Polish. It weighed an Ounce and a half, and its specifick Gravity was to that of Water, nearly as 1704 to 1000. Its Colour was pretty much the same with the former.

11. A Fragment of *A* weighing 23 Grains, being put in Stone Lime-water, and kept in a moderate Heat, was mostly all rotten and dissolved in little more than thirty Days.

A Fragment of *B* weighing 10 Grains, after two Days and nine Hours warm Digestion in the same Lime-water, had two Grains of its Substance rotten and dissolved.

12. Some Stone Lime-water that I made by slaking Quick-lime with boiling Lime-water, dissolved a Piece of *A* of five Grains in about seven Days.

13. A Fragment of *A*, Gr. vi. after seventeen Days cold Digestion in Stone Lime-water in the Month of *February*, had lost none of its Weight, nor was its Surface very sensibly softened, altho' it had somewhat of a rotten Appearance; while a Piece of *B* of 12 Grains, in six Days cold Maceration in the End of *May* had two and a half Grains of its Weight dissolved.

From this Experiment, together with N^o 20. and 57. below, one may be able to account for Dr. Lobb's having found Lime-water to have no Power of dissolving the Stone (*q*): For if the Lime-stone used in making the Water was not fresh from the Fire (*r*) and if the Experiment was made in an open Vessel, and in the Winter-season, it is no great Wonder if, even after a cold Maceration of twelve Weeks, there was no Appearance of Dissolution upon the Stone.

It

(*q*) Treatise of Dissolvents of the Stone, p. 326.

(*r*) That this was the Case, is highly probable, since he made his Water with unslaked Lime, which he, in the next Paragraph, tells us was Lime a little slaked.

It is observable, that although the Chymists seem generally to have been of opinion, that there lay concealed in Quick-lime a powerful Remedy against the Stone, which by their Art might be extracted out of it; yet none of these Authors, that I have met with, among the many Diseases for which they have highly commended Lime-water, so much as hint at its being serviceable in the Stone or Gravel; in which Diseases, however, its Virtue is, perhaps more remarkable than in any other. And one may almost venture to affirm, notwithstanding the Boastings of many Chymical Writers, of their Spirit of Quick-lime, and other secret Preparations of it, that its Virtues are more easily extracted, and more safely conveyed into the Blood by its Water, than any way else.

Having thus found a considerable Power of dissolving the *Calculus* in Stone Lime-water, I thought it might be worth while to enquire, whether Shell-lime possessed the same Virtue, and whether in a greater or less Degree.

14. A Piece of *A* weighing nine Grains, was dissolved by lying seventeen Days in Lime-water made with calcined Egg-shells, in a digesting Warmth; and this, I am apt to think,

might have happened somewhat sooner, had the Shells been more carefully calcined.

15. A fragment of *A* of six Grains was, by two Days warm Digestion in Lime water made with Oister shells, reduced to two Grains, and in three Days to less than one Grain.

16. A Piece of *B*, eight Grains, in thirty six Hours warm Digestion in Oister-shell Lime-water, had about three and one fourth Grains of its Substance dissolved.

17. Having calcined a few Cockle-shells, that had lain long exposed to the Weather, I put a Piece of *B*, eight Grains, in some of the Lime-water made with them; which in thirty six Hours warm Digestion lost near three and a half Grains.

The Lime-water, especially that from Shells, generally dissolves the Stone by making it throw off white rotten Crufts or Scales; which, if allowed to lie long enough among the Water, and if the Glass be shaken now and then, are reduced to a sort of white *Mucilage*, resembling in some Degree the white Sediment of N^o 9.; but which, when dried, has the Appearance of fine Powdered Chalk. This serves farther to shew that the white Sediment in the Urine of such as drink Lime-water,

water, is not derived from the Lime, but wholly from the Parts of the Stone, and grofser Parts of the Urine, thus changed by the Lime-water (f).

18. A Piece of *A*, fix Grains, was rendered pretty soft, and entirely rotten, by a cold Maceration of seventeen Days in Oyster-shell Lime-water, in the Month of *February*; but *May* 19. having infused, cold, a Fragment of *B*, eleven Grains, in some of the same Lime-water, it lost in three Days near five Grains, and in eight Days was reduced to a *Nucleus*, weighing three Grains.

Here it may be proper to observe, that, unless the *Calculus* be small, and the Quantity of Lime-water in which it is immersed, be large, the Water must be renewed at different Times, since its Virtues are weakened in proportion to the Quantity of the Stone which it has dissolved; and, as far as I have been able to observe, less than half a Dram of *Calculus* reduced to a fine Powder, is sufficient to destroy the Virtue of two Ounces of strong Lime-water in which it is infused.

From these Experiments it appears, that Oyster and Cockle Shell Lime-water possesses a much greater Power of dissolving the *Calculus*,

lus, than that of Stone-Lime. Nor is this last only inferior in its lithontriptick Virtue, but also as it is less homogeneous and safe, since the Lime-stone may be impregnated with metallick or mineral Principles, which even the Fire may not be able wholly to destroy.

Although, as has been already hinted, I don't find that Lime-water has been prescribed till of late in the Gravel, or for dissolving the Stone in the Bladder; yet, since the first Publication of these Papers, I have met with a Passage in an Epistle of *Olaus Borrichius* to *Thomas Bartholine*, by which it plainly appears, that the Power of Shell lime-water to dissolve the *Calculus* out of the Bladder, was long ago known to this Author. His Words are, *Constat autoritate Basilii Valentini aliorumque, nihil in calculo proffigando utilius spiritu calcis vivæ; mihiq; iterum iterumque compertum aquam calcis vivæ ostreorum, mytilorumque, solvere calculos ordinarie ab ægris exsectos in mucilaginem, si aliquot dierum leni fotu in calido simul detineantur* (t).

19. In order to know what Proportion of Water was best to be added to the Shell-lime, I poured twenty one Ounces of boiling Water upon three Ounces of fresh calcined Oyster-shells,

(t) Bartholin. epist. centur. iv. epist. 76.

shells, reduced to a gross Powder, and a great Ebullition soon ensued, which lasted a considerable Time. A Piece of *B*, thirty one Grains, by lying thirty six Hours in this Lime-water with a Heat betwixt that of the human Body and melting Wax, lost seven Grains of its Weight.

Having afterwards added twenty five Ounces of boiling Water to two and a half Ounces of the same calcined shells, there did not happen any such strong Ebullition as before; only a Noise at the Bottom of the Vessel, and some small Agitation in the Liquor, such as commonly is to be observed in Water before it begins to boil. A Piece of *B*, thirty one Grains, being kept thirty six Hours in this Lime-water in the above mentioned Heat, lost only five Grains.

To make therefore Lime-water with Oyster or Cockle-shells, the Proportion I would recommend is 7, or at most 8 *lib.* of Water to one of calcined Shells (*u*). Nor is there any Danger in the Strength of Lime-water made in this Manner; for I have ordered near four *English* Pints of it to be drank by a Man, and

two

(*u*) An earthen Vessel is preferable for this Purpose to a wooden or Copper one, as the first will probably give it a bad Taste, and the second possibly a worse Quality.

two by a Boy of eight Years of Age, every Day, without any Inconveniency. (x)

The Shells will calcine in any Fire, provided it be hot enough: and the Cockle and Oyster with much less Trouble than the Egg-shells. If they are friable, and quite white, they are sufficiently burnt; but if blackish or grey, they must be put into the Fire again.

It may perhaps be worth while to observe, that if any part of the Shells is blueish and not properly calcined, the Water poured on them will get a very disagreeable sulphureous Taste.

If cold Water be poured upon Shell-lime, very little Heat or Ebullition ensues; yet the Lime-water thus procured seems to have as great a Power of dissolving the Stone, as when made with boiling Water; but is more harsh and disagreeable, the other having a Softness and Sweetness which this wants.

The

(x) Farther Experiments have convinced me, that there is no need of being very nice as to the Quantity of Water to be added to Quick-lime: since the Difference of Strength will be inconsiderable, whether 8, 10, or 12 times its Weight of Water is poured upon it; provided the Water be allowed to remain long enough on the Lime, to be fully impregnated with its Virtues; the Neglect of which seems to have been, in a good measure, the Reason of the remarkable Difference between the dissolving Powers of the two Lime-waters last mentioned.

The Water, whether cold or hot, should be allowed to stand nine or ten Hours on the fresh calcined Shells; or longer, if the Quantity of Water added to them is in a greater Proportion than eight to one.

If any one before reading this Essay should chance to have consulted Mr. *Lymery* upon Lime-water, either in his Chymistry or *Pharmacopée universelle*, he will perhaps be surpris'd to find three or four *English* Pints of this ordered to be taken every Day, while that learned Chymist talkes of its Dose, as from one to four Ounces; speaks of its raising great Thirst, and being in danger of burning the Stomach; upon which account he orders Syrup of Violets to be mixed with it, and prefers the second Water to the first. Perhaps from such Authority it partly was, that many Physicians have been used to prescribe this Medicine with so sparing a Hand; and I own, that first when I began to order Lime-water for the Stone, I was afraid to exceed an *English* Pint of it a-day; but, as repeated Experience has taught me, that there is nothing to be dreaded from it when taken in much larger Quantities, I imagine Mr. *Lymery's* Suspicions of its doing Mischief in large Doses, or when taken unmixed with any thing to soften it, were not so much
owing

owing to any Experience of its bad Effects, as to Theory. Quick-lime is remarkably corrosive, and is believed to act by its Fire ; therefore it was natural to think, that Lime-water impregnated with the same Fire, might have the same Effect, though in a less Degree.

20. I infused a Fragment of *B*, seven Grains, in some Lime-water made with Oyster-shells that had lain thirty five Days in the open Air after Calcination ; which, being kept in a moderate Heat for four Days, had only about three Grains of its Substance rotten and dissolved ; whereas a Piece of *B*, eight Grains, by digesting three Days and twelve Hours in Lime-water made with Shells fresh from the Fire, lost about six Grains : Nay, I have observed, that after the Shells have been but twenty Hours from the Fire, they neither make such an Ebullition with the Water, nor impregnate it so quickly with their Virtues.

I have made Experiments with Lime-water and several other urinary Stones, but have never yet met with any that were able to resist the Oyster or Cockle Shell Lime-water, although some that were extremely hard, and of a dark brown Colour, dissolved a good deal slower than either *A* or *B*.

I had indeed sent me a few small Stones, all of them of a particular Shape, resembling pretty much the Stone of a Raisin, perfectly smooth, and variegated something like a polished Pebble; to which their exterior *Cortex* scarcely yielded in Hardness. Upon these the Lime water had no manner of Influence. But if these Stones came from the urinary Passages, as I was told, they were of a Texture quite different from all the Gravel stones I have ever seen; and their being all pretty much of one Bulk and Shape, makes it probable that they were generated in some particular Cavity. In the *Philosophical Transactions* (v) we have the History of a Woman in *Switzerland*, who passed by the *Anus* great Quantities of Stones like Flint. And I have seen a Concretion passed by Stool, longer, but not so thick as a Hen's Egg, with its exterior *Cortex* as smooth as a polished Pebble, though internally it was of a spongy fungous Consistence. In the same *Transactions* we read of a Shell having been found in one of the Kidneys of a Lady who had been often subject to violent Vomitings (w); which it is very likely the Lime water would not have dissolved. And *Bartholine* mentions Stones

D

said

(v) Lowthorp's Abridgment. Vol. 3. p. 167.

(w) Lowthorp's Abridgment. Vol. 3. p. 162.

said to have been extracted from the Bladder, of a flinty Hardness (x) ; tho' *Olaus Borrichius* seems to doubt of this (y). But as these Concretions are as different in their Nature from common *Calculi*, as Flint or Shells are from Free-stone, and besides are extraordinary and very rare, Lime-water (especially that from Oister or Cockle Shells) may be still looked upon as a pretty universal Dissolvent of calculous Concretions.

As the calculous Concretions of the Urine have been thought to have some Analogy to the tartarous Crust left by Wine upon the Sides of the Cask, it may perhaps be worth while to observe, that Lime-water dissolves *Tartar* pretty quickly ; but as its Virtue is soon destroyed by the Acidity of the *Tartar*, the Affusion of fresh Lime-water must be frequently repeated.

21. The Reverend and ingenious Dr. *Stephen Hales* having wrote me (*May 1751.*) that he had found Oister-shell Lime-water, made with a Pound of Lime to an *English* Gallon of Water, rendered sensibly more pungent to the Taste, as well as a more powerful Solvent of the Stone, by pouring it on calcined Shells

red-

(x) Epist. 45. cent. 4.

(y) Barthol. epist. 76. cent. 4.

red-hot from the Fire ; I made the following Experiments with a view to determine with some Precision the different Strength of different Lime-waters.

(a) *June 6.* At Nine in the Evening, I poured upon a Pound of calcined Oister-shells hot from the Fire, seven Pounds of boiling Water.

(b) Next Day, at Eight in the Evening, I poured two Pounds of this Lime-water upon half a Pound of calcined Oister-shells newly taken from the Fire, and still warm. Thirteen Hours after this, I decanted off and filtered fourteen Ounces of each of these Waters.

(c) At the same time I filtered the like Quantity of Lime-water, which was procured by pouring, forty eight Hours before, seven Pounds of boiling Water upon a Pound of calcined Oister-shells, which, in the Space of four Days and a half, had formerly got three such Waters.

(d) I filtered also fourteen Ounces of Lime-water, made by pouring seven Pounds of boiling Water upon one Pound of Stone-lime, taken a few Hours before from the Fire.

In order to find the specifick Gravities of these different Lime-waters (the first of which we shall, for brevity's sake, call A, the second B, the third C, and the fourth D), I weighed

with the Assistance of my Colleague Dr. *John Stuart* Professor of Natural Philosophy, a large Glass-phial (filled with Sand, and hermetically sealed) first in Air, and then immersed it in the Fountain-water of this City (used also in making the several Lime waters), by which it lost 3704 Grains of its former Weight. Being next weighed in B, it lost 3727 Grains. In A it lost 3720 Gr. ; in C 3710 Gr. ; and in D 3713. Hence it appears that the specifick Gravity of the double Lime-water B, was to that of *Edinburgh* Water, nearly as 169 to 168. The Gravity of A was to that of the same Water, nearly as 232 to 231 ; of C, nearly as 617 to 616 ; and of D, nearly as 411 to 410. At another time I found, by the same method, the specifick Gravity of some Lime-water procured from Oyster-shells ; upon which, during the Course of twelve Months, I had at different times poured, at least, a hundred times their Weight of Water, to be to that of Fountain-water, nearly as 926 to 925.

It may be proper to observe, that both A and B were made with Oyster-shells, which had lain buried in the Rubbish on the South-side of the Castle of *Edinburgh*, probably above a hundred Years ; because, if they had been newly got from the Sea, the Salt which they contain

contain even after Calcination, would probably have increased the specifick Gravity of the Waters poured on them, and so have rendered the Experiments less accurate.

The Tastes of A, B, C, and D, as well as their specifick Gravities, shewed their different Strengths. A and B had much the same kind of Taste, but B was sensibly more pungent; C had much less Pungency than either of the two former, and left a Sweetishness in the Mouth, somewhat resembling the Taste of Liquorice Root; D did not differ much from C as to its Taste.

I put three Pieces of a very hard *Calculus*, each weighing ten Grains, into three different Phials; one of which I filled with the Lime-water A, another with B, and the third with C. After they had stood in the same Degree of Warmth 93 Hours, I found that the *Calculus* in the double Lime-water B, had two Grains of its Substance dissolved or rotten; the *Calculus* in A had lost somewhat more than a Grain and a half; and that in C, a Grain.

Hence it follows, that Water does not acquire the same precise Degree of Strength, whether five or five hundred times its Weight of Water be poured on Quick lime; but that, strictly speaking, Lime-water is stronger or

weaker as a greater or less Quantity of Quick-lime is added to the Water; that where the Proportions of these two are equal, fresh calcined Shells impregnate Water more strongly, than such as have had several Affusions before; and that Lime-water, made with calcined Shells, hot from the Fire, may be rendered remarkably stronger, by pouring it a second time on fresh burnt Shells. It is, however, observable, that this double Lime water, notwithstanding it remains on the Shells, loses in a few Days part of its Pungency and Strength, while the weaker Lime-waters seem to be constantly supplied with fresh Virtue from the Shells, sufficient to make up what they lose by the Contact of the Air.

Farther, we see that Stone-lime does not impregnate Water so strongly with its Virtues as Shell-lime. Whether this may be owing to the greater Subtility of the latter, whereby it more easily mixes with, and is suspended in the Water, or whether it may not proceed from some other Cause, I shall not presume to determine: However, from the greater specifick Gravity of Shell Lime-water, we are enabled to account for its dissolving the *Calculus* more powerfully than Stone Lime-water.

But

But altho', from the above Experiments, it evidently appears, that fresh calcined Shells afford a stronger Water than such as have been exposed for any considerable Time to the Air, and that the first Water poured on Quick-lime is stronger than the succeeding ones; yet it is far from being true, that Quick-lime is soon deprived of its Virtues by repeated Affusions of Water, or that the third or fourth Water procured from it is altogether insipid, as some have affirmed (z). 'Tis true, indeed

(z) *Memoires de l'Acad. des Sciences* 1700, Edit. 8vo p. 160 and 170. *

* It seems to have been the common Opinion, that the first and second Waters got off Quick-lime, are not only the strongest, but that the third, fourth, and succeeding ones are almost insipid and destitute of any Virtue.——
—— But Doctor *Alston* has lately informed us, that Quick lime not only continues to communicate its Virtues to Water much longer than any one had imagined before, but also affirms, that the last Water is as strongly impregnated with the Virtues of the Lime as the first. *Philosoph. Transact.* v. 47. p. 266. and *Dissertation on Quick lime, &c.* p. 4. 5. and 6. In this Case, however, as in many others, the Truth is wholly on neither Side; for altho' Quick-lime does communicate its Virtues to Water much longer than any one could have expected before making the Trial, yet it is most certain, that the Waters got off Quick-lime become gradually weaker, and that the first Water contains more of the Lime, and is stronger, more pungent and disagreeable

indeed, that fresh calcined Shells impregnate Water with their Virtues sooner, as well as in a greater Degree, than Shells which have been in some measure flaked by long Exposition to the Air; and that when repeated Waters are poured upon Quick-lime, it communicates its Virtues not only more slowly, but also, strictly speaking, in a less Degree, to each succeeding Water (a): But nevertheless, Quick-lime is so far from having its Virtues wholly extracted by a few Affusions of Water, that some Stone-lime, which had been reduced to a Powder, by being exposed to the open Air for four Months, still retained some of its Virtue, after having had, during

agreeable to the Taste, than the 10th, 12th, or succeeding ones. The Discovery therefore, of which the Doctor claims the Honour †, and indeed justly, comes out to be partly real, and partly imaginary: And the Reason why the Author of this Essay took no particular notice of this Discovery, in the former Edition, was the Aversion he had to criticise upon his good Friend, or to enter into any Controversy with him.

(a) Calcined Shells, taken fresh from the Fire, will, in less than 24 Hours, communicate all the Virtue they can give to seven or eight times their Weight of Water; but after they have had twelve or fourteen Waters poured on them, several Days must pass before the Water gets all the Strength, which the Lime can give it.

† Dissertation on Quick-lime, p. 47.

ring the Course of fixty Days, 260 times its Weight of Water poured upon it: and some Lime-water procured from calcined Oister-shells, upon which, in 48 Days, I had poured 270 times their Weight of Water, was, by Experiment, found to be possessed of a considerable Power of dissolving the Stone.

Hence we may see why Lime, which has been used, since the Times of the *Romans* (b) as a Manure, retains its Power of fructifying the Ground for many Years.

It follows also, from the above Experiments and Observations, that calculous Patients may not only use, with Advantage, the first, but also several more Waters procured from Quick-lime: And, perhaps, it were advisable for them to begin with the 3d and 4th Waters, and use them for some Days before they try the first Water, which has a more pungent and disagreeable Taste.

My

(b) *Hedui et Pictones calce uberrimos fecere agros; quae sane et oleis, et vitibus utilissima reperitur.* Plin. *Histor. Natural.* lib. 17. cap. 8.

My worthy Colleague Doctor *Alston*, being neither satisfied with the above Experiments, concerning the Strength of different Lime-waters, nor with the Conclusions drawn from them, has, in the first Edition of his Dissertation on Quick-lime, endeavoured to destroy their Credit, by Arguments chiefly taken from the Imperfection of the hydrostatical Balance, and from the supposed Nature of Quick-lime and its Water. These I should have passed over in silence; but as some of the Doctor's Experiments came out different from mine, in order to know whether I might not have been mistaken in what I had formerly advanced, I thought it necessary to make some new Trials; (a) which have given occasion to very ample Remarks (b), but have equally failed of satisfying my Friend as the former; for he still maintains, that Lime continues (till it be exhausted of its Virtues) to impregnate Water as strongly as when first taken from the Fire; that Shell-lime Water is not stronger than that which is made with Stone-lime, and that Lime-water cannot be made stronger by pouring it a second time on fresh Lime.

To

(a) Vid. *Edinburgh Physical Essays*, vol. 1. art. xiii.(b) *Dissertation on Quick-lime*, 2d edit. p. 58, &c.

To answer all the Doctor's Objections to my Experiments, and his Arguments in favour of his own Notions, would be to me an unpleasant Talk, and afford to the Reader but disagreeable Entertainment: I shall therefore content myself with relating a few simple and easy Experiments, which, far from throwing Dust upon and darkening, serve to decide the Matter in dispute.

I. (1.) *June 20. 1754*, I poured upon four Ounces of Oister-shell Lime, reduced to a gross Powder, rather more than eight times its Weight of Water. After 24 Hours, I filtered 12 Ounces and one Dram *Averdupois* Weight, of this Lime-water, thro' brown Paper, and added to it 30 Grains of Salt of Tartar: the white Powder which fell to the Bottom, being separated from the Water by Filtration, and well dried, weighed full 13 Grains.

(2.) After this, in the Course of seven Days, I poured upon the same Oister-shell Lime a 2d, 3d, 4th, 5th, and 6th, time the same Quantity of Water; after the sixth Water had stood thirty six Hours on the Lime, I filtered it, and added 30 Grains of Salt of Tartar to 12 Ounces and one Dram of it. The white Powder which fell to the Bottom, being well dried, weighed 10 Grains.

(3.) After-

(3.) Afterwards, viz. from *June 28. to July 6.* I poured upon the above Lime the same Quantity of Water a 7th, 8th, 9th, and 10th time. The tenth Water having been filtered after it had stood on the Lime three Days; 12 Ounces and one Dram of it mixed with 30 Grains of Salt of Tartar, afforded of white Powder $8\frac{1}{2}$ Grains.

(4.) From *July 6. to August 7.* I poured on the same Lime, seven Waters more; the last of which, being the 17th, was not filtered till it had stood on the Lime seven Days. Twelve Ounces and a Dram of it mixed with 30 Grains of Salt of Tartar, yielded 7 Grains of white Powder.

II. (1.) *July 3.* I poured upon four Ounces of Stone lime, about twenty Hours after it had been taken from the Kiln, near nine times its Weight of Water. After 24 Hours, I decanted off and filtered the Water. Twelve Ounces and one Dram of it mixed with 30 Gr. of Salt of Tartar, afforded scarcely 10 Grains of a white Powder.

(2.) Afterwards, in the Space of twenty one Days, I poured on this Stone-lime nine Waters more; the last of which being the 10th, was allowed to remain on the Lime three Days. Twelve Ounces and one Dram
of

of it mixed with 30 Grains of Salt of Tartar, gave $8\frac{1}{2}$ Grains of white Powder.

(3.) After this, in the course of 41 Days, I poured on the same Stone-lime seven Waters more; the last of which, being the 17th Affusion, was not filtered till it had stood full seven Days on the Lime. Twelve Ounces and one Dram of it mixed with 30 Grains of Salt of Tartar, gave 7½ Grains of white Powder.

III. (1.) The above Lime-waters were all made in glazed earthen Vessels, the Mouths of which were not covered; this being the common way of making Lime-water, and that which both Dr. *Aylton* * and I generally observed. But that I might know what Difference would be produced in the Strength of the Water by infusing the Lime in a close Vessel, I put three Ounces of Oyster-shell Lime into a Glass-bottle, adding to it 27 Ounces of Water. Having closely corked the Bottle, I let it stand seven Days (shaking it, however, once every Day); twelve Ounces and one Dram of it being filtered and mixed with 30 Grains of Salt of Tartar, gave $15\frac{1}{2}$ Grains of white Powder.

(2.) At

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* The Experiments in the Dissertation on Quick-lime, (1st Edit.) p. 4, 5, 6, & 7, which first led Dr. *Aylton* to think there was no Difference between the 1st and 20th Lime-waters, were all made in open Vessels.

(2.) At the same time, I put into another Bottle three Ounces of Stone lime, with 27 Ounces of Water. After an Infusion of seven Days, twelve Ounces and one Dram of this Water, mixed with 30 Grains of Salt of Tartar, afforded $11\frac{3}{4}$ Grains of white Powder.

(3) I put also into a crystal Bottle, with about eight times its Weight of Water, the Oyster-shell Lime that had got 17 Waters before. Having close-stopt the Bottle, and let it stand seven Days, I filtered the Water, and found that twelve Ounces and one Dram of it, mixed with 30 Grains of Salt of Tartar, gave $9\frac{1}{3}$ Grains of white Powder.

The same Quantity of the 18th Infusion, in a close-stopt Bottle, of the Stone-lime (II.), afforded $9\frac{1}{2}$ Grains of white Powder.

(4.) I infused 20 Grains of Stone-lime, in 25 Ounces or 600 times its Weight of Water in a corked Bottle, for seven Days; after which, 12 Ounces and one Dram of the Water, filtered and mixed with 30 Grains of Salt of Tartar, gave near 9 Grains of white Powder.

The same Proportions of Stone-lime and Water being infused for the same Time in an open Vessel, 12 Ounces and one Dram of the
Water

Water afforded, with the same Quantity of Salt of Tartar, only $3\frac{1}{4}$ Grains of white Powder.

(5.) Twenty Grains of Oister-shell Lime, infused, in a close-stopt Bottle, in 600 times its Weight of Water, after seven Days, gave a Lime-water; 12 Ounces and one Dram of which, afforded $8\frac{1}{2}$ Grains of white Powder.

(6.) Thirty Grains of Oister-shell Lime being infused in 400 times its Weight of Water, in a close-stopt Bottle, for seven Days, afforded a Lime water; twelve Ounces and one Dram of which gave 10 Grains of white Powder.

The same Proportions of Oister-shell Lime and Water having stood during six Days in an open Vessel; 12 Ounces and one Dram of the Water gave 4 Grains.

Since the Quantity of calcarious Powder, precipitated upon mixing Lime-water and Salt of Tartar, must be in proportion to the Strength of the Lime-water, whether this Powder be supposed to arise from the Salt or from the Water, or from both *, it must follow from the above Experiments,

I. That Quick-lime communicates more of its Virtues to Water at first, than afterwards; and although the Difference between

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the

* It will be shewn in Sect. ix. below, that the Precipitation is almost wholly from the Lime-water.

the first and second Waters, may be so small, as scarcely to be discoverable by our Senses; yet the sixth is manifestly weaker than the first; the tenth is weaker than the sixth, and the seventeenth is weaker than the tenth. It is, however, observable, that this Decrease of Strength is greater in Oyster-shell, than in Stone lime Water.

2. It appears, that when Oyster-shell Lime has 400, and Stone-lime has 600 times its Weight of Water poured on it *, less Virtue is communicated to the Water, than when the Proportion of the Water to the Lime, is as 8 or 9 to 1. And this holds true, whether the Infusion be made in open or close Vessels.

3. Although Oyster-shell Lime did not impregnate 600 times its Weight of Water quite so much as Stone-lime, which may be owing, perhaps, to its not having been perfectly calcined; and altho' Stone-lime impregnates Water rather more strongly than Oyster shell Lime, after they have had 16 or 17 Waters poured on them; yet it is evident, that Oyster-shell Lime communicates, at first, a good deal more Virtue to Water than Stone-lime; and this seems to be the Reason why it is much more weakened by the first ten Infusions, than the Stone-lime.

Dr.

* Dr. *Alston's* Dissertation on Quick-lime, p. 6.

Dr. *Alston* has called in question the superior Virtue of Oister-shell Lime-water; but, in many repeated Experiments which I have made upon *Calculi*, this and Cockle-shell Lime-water proved always the strongest Dissolvents: My ingenious Friend Dr. *Home* has observed, that Shell-lime Water corrodes Linen faster than Stone-lime Water: and *Mess. Du Hamel* and *Grosse* found, above 20 Years ago, that a greater Quantity of Tartar was dissolved by Oister-shell Lime-water, than by that made with Stone-lime *.

4. It is so far from being true, as Dr. *Alston* imagines †, that Lime, as long as it retains any Virtue, will impregnate Water with as much of its finer Part as it can receive, that Quick-lime does not give, even to the first Water, when made in an open Vessel, so much of this as the Water can take; since the Water may be rendered sensibly stronger; by making it in a close-stopt Bottle. And, it is worth remarking, that the Difference of the Quantity of calcarious Powder, afforded by the 1st and 17th Infusions of Oister-shell

E 3

Lime

* *Memoir. Acad. des Sciences. An. 1732. Edit 8vo,*

p. 454.

† Dissertation on Quick-lime, p. 54.

Lime in open Vessels, and by the 1st and 18th Infusions of it in close-stopt Bottles, was nearly the same, viz. about 6 Grains. But when a very small Quantity of Quick-lime was infused in a great deal of Water, the Difference of Strength between the Infusions in close and open Vessels was greater, because, during the seven Day's Infusion, the Water in the open Vessel lost a great deal of its Virtue, which the Lime could not supply; while in the close-stopt Bottle, the Water was always getting something from the Lime, and, in the mean time, lost little or nothing.

5. If Lime-water, made in an open Vessel, be weaker than when it is made in a close one, why may not single Lime-water acquire some more Strength by the Addition of fresh Lime, since it is manifest, it can take up more of the Virtue of the Lime than it had before? It is probable, however, that when Lime-water is made in close-stopt Bottles, the Addition of fresh Lime to it, will not make near so great a Difference of Strength in it, as when the Infusion is made in open Vessels *.

6. That

* I infused, in a close-stopt Bottle, 3 Ounces of Oyster-shell Lime, in 27 Ounces of Water; after 12 Hours I added 6 Ounces more of the same Lime fresh from the Fire,

6. That Lime-water made in open Vessels, may acquire more Strength by having fresh Lime added to it, the Experiments related above (p. 40.) with those in the *Physical and literary Essays* *, seem to demonstrate. Nay, Dr. *Alston* himself owns, that having weighed some quadruple Lime-water (which, by the bye, from the small Proportion of Lime added each time to the Water, should not have been so strong as our double Lime water B, p. 39. above) in a Flask, which contained 8940 Gr. of single Lime-water, he found its Weight to be 8947 Grains †. But tho' the Doctor is, at last, convinced by the Force of his *own* Experiments,

Fire, and in less than two Days filtered the Water; 12 Ounces and 1 Dram of which gave, with 30 Grains of Salt of Tartar, very near 16 Grains of white Powder. But, as the Water tasted very strong of the Lime, I added to it 15 Grains more of the Salt of Tartar, and had, by Filtration, 1 Grain of calcareous Powder: So that this double Lime-water afforded near 17 Grains of Earth. Let it not be said here, that the Grain of white Powder got by the Addition of the 15 Grains of Salt of Tartar, proceeded from the Salt; since, when that Quantity of this Salt is dissolved in common Water, the Precipitation does not amount to $\frac{1}{7}$ of a Grain. Whether this double Lime water might not have acquired yet more Strength, had it stood longer on the Lime, I cannot say, not having had Leisure to repeat the Experiment.

* Vol. I. art. xiii.

† Dissertation on Quick-lime, 2d edit. p. 61.

riments, that double Lime-water may be heavier than single; yet he will not allow even the very small Excess of Gravity in his quadruple Lime water to be owing to its containing more of the Lime than single Lime-water, but to some heterogeneous Substances dissolved in it. And this he thinks he has proved, by finding that the Flask filled with this quadruple Lime water, after it had thrown up its Crufts, exceeded the same Flask filled with common Water by four Grains.

Even this Experiment, supposing it were liable to no Objection, accounts only for about one half of the Difference of Weight between the Doctor's single and quadruple Lime-water. But if we consider the thing more accurately, we shall see that no great Stress can be laid upon it. For, not to mention that if the single Lime-water had been weighed after throwing up its Crufts, it might perhaps have differed not much less from common Water in specific Gravity, than the quadruple Lime-water did; was the Doctor sure this last Water was quite effete? I found, that, after nineteen Days Exposition to the open Air, twelve Ounces of strong Lime-water, upon being mixed with eight Grains of Salt of Tartar, afforded $1\frac{1}{2}$ Grains of calcarious Matter, when 30 Gr.

of

of the same Salt dissolved in common Water, did not afford the $\frac{1}{6}$ part of that Quantity. Is it not, therefore, more than probable, that the four Grains, by which the effete quadruple Lime-water exceeded common Water in the Doctor's Experiment, were partly, if not wholly, owing to its not being entirely deprived of its Lime? and this the rather, that he only exposed this Lime-water ten Days to the open Air *.

Farther, when the Difference of specifick Gravities amounts only to a few Grains, one cannot safely rely on such a Machine as the Doctor used; and to set it up in opposition to the hydrostatical Balance, would be much the same, as if one should contend that he could describe a Circle as accurately without Compasses as with them.

I shall

* What is here suggested may shew, why Dr. *Alston* did not find a sensibly greater Quantity of Crusts in double, than in single Lime-water; and that the Strength of Lime-waters cannot be exactly determined by the Quantity of Crusts which they throw up, unless the Water is either evaporated, or allowed to stand till it gives no more Precipitation with Salt of Tartar, than common Water; neither of which Methods were observed by the Doctor in his Experiments.

I shall only add, that double Lime-water not only appeared, by its Taste and Effects on the Stone, stronger to Dr. *Hales*, than single Lime-water, but, by its Weight, Mixture with Claret, &c. convinced me also of its superior Strength: and Dr. *Home* has found, that Lime-water acquired a greater Degree of Hardness by being poured a second or third time upon Quick-lime. So that, upon the whole, if I be mistaken in thinking that Lime-water may be rendered stronger by adding fresh Lime to it, I shall, at least, have the Excuse of not being *singular* in my Mistake.

I might have adduced more Experiments in support of what I had formerly said on the Strength of different Lime-waters, but choosed not to mention any that were in the smallest degree equivocal, or whose Force could be distinguished away by the Arts of Disputation.

T A B L E

T A B L E *of the Strength of different Lime-waters according to the foregoing Experiments.*

OISTER-SHELL LIME-WATER

MADE

In open Vessels.

In close Vessels.

Infusions.	Strength.	Infusions.	Strength.
First - - -	13	First - - -	15 $\frac{1}{2}$
Sixth - - -	10	Eighteenth	9 $\frac{1}{3}$
Tenth - - -	8 $\frac{1}{2}$		
Seventeenth -	7	With 400 parts of Water to one of Quick-lime -	10
With 400 parts of Water to one of Quick-lime -	4	With 600 parts of Water to one of Quick-lime -	8 $\frac{1}{2}$

STONE-LIME - WATER

MADE

In open Vessels.

In close Vessels.

Infusions.	Strength.	Infusions.	Strength.
First - - -	10	First - - -	11 $\frac{3}{4}$
Tenth - - -	8 $\frac{1}{2}$	Eighteenth	9 $\frac{1}{2}$
Seventeenth -	7 $\frac{1}{3}$		
With 600 parts of Water to one of Quick-lime -	3 $\frac{1}{4}$	With 600 parts of Water to one of Quick-lime -	9

S E C T.

S E C T. IV.

Experiments with Lime-water and some of the animal Humors.

THE great Power of Lime-water to dissolve the *Calculus*, being sufficiently made out in the above Experiments, the next Subject of Inquiry seemed to be, How far the Nature of Lime-water would be changed by its being mixed with the Humors of our Body, and consequently what Probability there was of its carrying its Virtue along with it to the Bladder.

22. I infused a Piece of *B*, three Grains, in a Mixture of *Saliva* and Oister Lime-water, in the Proportion of one of the former, to two and a half of the latter: Its Surface in a few Hours began to turn white; and, upon shaking the Glass, threw off white Scales; and, in two Days warm Digestion, it was reduced to a Grain and a half.

23. I immersed another Fragment of *B*, three Grains, in an Ounce of *cystick Bile*, and three Ounces of Oister Lime-water, which being kept in a moderate Heat forty two Hours, had near one Grain and a half of its Substance dissolved in the Form of thin whitish Scales.

[23.] A piece of *B*, five Grains, being infused in one Part Serum of human Blood, and three and a half Parts Oyster Lime-water, was, after thirty eight hours warm, and sixteen cold Digestion, reduced to three Grains.

24. I put also a Piece of *B*, five Grains, in a Mixture of one Ounce of fresh Urine and three Ounces of Oyster Lime-water: After digesting three Days in the same Heat with the last, its Surface was become all over white, about a Grain of it was dissolved, and the rest somewhat rotten and friable.

Since, from these Experiments, it appears, that the animal Humors have nothing in their Nature peculiarly destructive of the dissolving Quality of Lime-water, we might reasonably conclude *a priori*, that it should carry its Virtue along with it even to the Bladder, and so in time dissolve the Stone.

SECT. V.

Experiments with Lime-water, and fermented Liquors and Spirits.

HAVING shewn the Probability there is that the animal Fluids will not destroy the Virtue of Lime-water, we come next to inquire,

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How far it may be affected by such Liquors as are most commonly drunk in this Country.

25. *Claret Wine* destroys the Taste of near double its Quantity of Lime-water, and the Liquor has the Colour of the Wine rather heightened, and the Taste of Wine and Water; but, upon adding a little more Lime-water, it acquires a blackish Colour, not unlike Gun-powder, and begins to discover a little of the Taste of the Lime. The Quantity required to produce this Change of Colour in the Claret varies according to the Strength of the Lime-water. Having once slaked some Quick-lime with boiling Lime-water, I found that the Water made in this Way, turned Claret black, when mixed with it in the Proportion of one and a half to one.

I took two Pieces of A, each weighing twenty three Grains: The one being put in Lime-water, and kept in a moderate Heat, in five Days had near five Grains rotten and dissolved; the other being put in one Part Claret and two Parts of the same Lime-water, and kept in the same Heat for fifteen Days, lost nothing of its Weight, nor was its Surface at all softened.

26. An Ounce of Lime-water mixed with an equal Quantity of *strong Ale*, not in any degree stale, having been but fourteen Days in the Bottle, had its Taste quite destroyed, at the same time that it weakened the malty Taste of the Ale more than an equal Quantity of common Water. A Piece of *A*, weighing ten Grains, after lying thirteen Days in this Mixture in a moderate Heat, had lost nothing of its Weight, nor were there any Signs of Dissolution about it.

Small Beer has the same Effect, but in a less Degree:

27. Upon mixing Lime-water and *Vinegar*, there does not arise any Effervescence or Ebullition; one Ounce of the latter destroys the Taste of ten or twelve of the former; and a Fragment of *A* that weighed four Grains, after lying eight Days among this saturated Mixture in a moderate Heat, had lost nothing, nor was it any way softened.

Hence it seems proper for such as use Lime-water, to abstain not only from all Acids, but also from Wine, Ale, and, so far as I have been able to observe, all fermented Liquors. And doubtless Mrs. *Stephens*, by ordering her Powder to be taken in a Teacupful of White-wine, Cyder, or small Punch,

must have greatly impaired the Strength of it, and rendered it much less effectual (altho' less offensive to the Stomach) than otherways it would have been.

28. A Spoonful of *West-India Rum* mixed with the same Quantity of Lime-water, produces a Liquor of a fine Limon-colour, both tasting and smelling strong of the Lime. A little Vinegar added to this, immediately changes its Colour, and destroys all Taste of the Lime.

Rum, in which so much *Limon-peel* had been infused as to give it a yellow Colour, being mixed with an equal Quantity of Lime-water, acquired a stronger yellow Colour; but immediately became turbid; which was owing, I suppose, to the Change made by the Action of the Lime-water upon that Oil with which the Limon skins abound, and to which the yellow Colour of the Rum was owing.

29. Equal Parts of *French Brandy* and Lime-water, produce a Liquor higher coloured than the Brandy was before, but tasting strong of Lime. In an Hour or two there falls to the Bottom a brown Sediment, (especially if the Brandy was high-coloured), and the Liquor above becomes of a Limon-colour,

not

not tasting of Lime; but when the Sediment is stirred up, it tastes as before.

Much the same thing happens to *Malt-spirits* and *Rum*, when mixed with Lime-water; and in proportion as these Spirits are more or less free of Colour, so is the Sediment that falls to the Bottom. From this we see, that tho' these Spirits do not destroy the Taste of Lime-water, yet they have a Power of making the Lime precipitate in a short time, which, when it falls to the Bottom, carries along with it whatever is mixed with these Spirits in order to colour them.

30. Having infused a Piece of *B*, two Grains, in one Part *Malt-spirits*, and two Parts Oister Lime water; in thirty five Hours warm Digestion its Surface was become white, and it had about one third of a Grain of its Substance dissolved.

From these Experiments we may conclude, that if such Persons as drink Lime-water, cannot confine themselves to watery Liquors, it will be better to allow them a little weak Punch made without Acids, than Wine, Ale, or any fermented Liquors.

S E C T. IV.

Experiments with Lime - water and animal Food, also Milk, Honey and Sugar.

31. I put a Piece of *B*, six Grains, in a Mixture of one Part *Mutton-broth* and two Parts Oister Lime-water, which, after three Days warm Digestion, had two Grains of its Substance dissolved.

32. At the same time having added half an Ounce of a strong Decoction of fresh *Cod-fish* to an Ounce and a half of Oister Lime-water, I immersed in it a Fragment of *B*, four Grains, which in the same Heat was in three Days and twelve Hours reduced to one Grain.

Hence we may conclude, that animal Food may be allowed to such as are under a Course of Lime-water for the Stone.

33. A Fragment of *B*, near five Grains, being put in a Mixture of one Ounce of *Milk* and four Ounces of Oister Lime-water, after digesting forty two Hours in a Heat rather greater than that of the human Body, had some of its Substance dissolved under the Appearance of white Scales, and the great-

est

est Part of it was become rotten, so as to crumble down upon pressing it with one's Nails.

34. Having dissolved two Drams of *Honey* in three Ounces of Oister Lime water, I digested in it a Piece of *B*, five Grains, fifty six Hours in a moderate Heat, it lost only one Grain of its Weight, and what remained was as hard as ever.

35. I immersed a Piece of *B*, five Grains, in three Ounces of Oister Lime-water, in which was dissolved two Drams of white *Sugar*; in forty eight Hours warm Digestion, it was reduced to three Grains; and what remained did not seem quite so hard.

Thus it appears, that *Honey* destroys, in a good measure, the dissolving Virtue of Lime-water, while the same Quantity of *Sugar* weakens it but very little. As in mixing Lime-water and Honey together, a pretty disagreeable Smell arises, they seem to suffer some Change in their Nature, by which the Virtue of the Lime-water is much weakened. This may be also in part occasioned by the active Particles of the Lime-water being inviscated and sheathed by the balsamic Parts of the Honey.

SECT.

S E C T. VII.

Experiments with Lime-water and several Fruits, Herbs and Roots.

THAT such a Diet may be ordered for calculous Patients as will least destroy the Virtue of Lime-water ; after the Experiments upon animal Food, we shall relate the Effects of different vegetable Substances upon it.

36. I infused a Fragment of *B*, eight Grains, in half an Ounce of Juice of *Strawberriess*, and two Ounces and an half of Oister Lime-water ; after four Days warm Digestion, and seven Days cold, it had lost none of its Weight, nor was there any Appearance of Dissolution about it.

37. I digested a Piece of *B*, six Grains, in half an Ounce of Juice of *Cherries* and three Ounces of Oister Lime-water, six Days warm ; but its Surface was neither softened, nor its Weight diminished.

38. A Fragment of *B*, six Grains, being put in a Mixture of one Ounce of a strong Decoction of *Raisins* and three Ounces of Oister Lime-water, was not any way changed by three Days warm Digestion.

From

From these Experiments we may infer, that all Fruits which have any Acidity or sharpness, whether fresh, as Gooseberries, Strawberries, Cherries, Apples, Pears, Plumbs, Peaches, &c. or dried, as Raisins, Prunes, Currants, &c. ought to be abstained from by such as use Lime-water with a view to the Dissolution of the Stone.

39. I infused a Fragment of *B*, five Grains, in one Ounce of a Decoction of *Asparagus* and two Ounces of Oister Lime-water; in a few Hours its Surface began to turn white, and, in thirty six Hours warm Digestion, it had thrown off, in white Scales, a full Grain of its Weight. As the grosser Parts of the *Asparagus* fell always to the Bottom of the Glass, it was necessary to keep the *Calculus* suspended in the Middle of the Mixture, by means of a Thread, otherways the Dissolution does not succeed quite so well.

Artichokes seem to destroy the Virtue of Lime-water a little more than *Asparagus*.

40. A Piece of *B*, nine Grains, by Digesting warm, four Days, in one Ounce of a Decoction of *Turnip*, and two Ounces of Oister Lime-water, lost more than a Grain.

41. A Fragment of *B*, three Grains, being put into a Mixture of a Decoction of *Parsley* and

and Lime-water, in the above Proportion; in three Days warm Digestion was reduced to one and one fourth Grain, having thrown off the rest in whitish Scales.

42. In an Ounce of Decoction of *Onions*, and two Ounces of Oister Lime-water, a Piece of *B*, of seven Grains, lost, by thirty six Hours warm Digestion, one Grain.

43. Juice of *Lettuce* mixed with Lime-water destroys its Virtues rather more than any of the above.

44. A Fragment of *B*, nine Grains, in one Ounce of a strong Decoction of *Althea Root*, and two Ounces of Oister Lime-water, had, by two Days and eighteen Hours warm Digestion, above a Grain of its Substance dissolved, and a good Part of the rest rotten and friable.

45. I put a Piece of *B*, fourteen Grains, in Oister Lime-water, in which some *Juniper-berries* had been infused; which, in two Days and a half, had above two Grains dissolved.

Green and *Bohea Tea* infused in the same manner do not considerably destroy the Virtue of Lime-water.

I might have tried the Effect of a great many more vegetable Substances upon Lime-water,

water, had I not been afraid of swelling this Essay to too great a Bulk; but, from these few Experiments, it is probable, that most of the following Vegetables may be safely used by such as drink Lime-water, *viz* Artichokes, Asparagus, Spinnach, Lettuce, Succory, Parsley, Purslane, Onions, Leeks, Cellary, Turnip, Carrot, Potatoes, Radishes, Green Pease*.

S E C T. VII.

Experiments with Lime-water and several Medicines.

46. HAVING dissolved *Tartar solubilis drach.* i. in Lime-water *Unc.* i. *sem.* I put in it a Piece of *B*, four Grains, which, though kept in warm Digestion five Days and a half, had not lost any thing of its Weight, but was become somewhat more friable.

47. I

* The Juices and Decoctions of *Onions*, *Leeks*, and *Cellary*, are observed to have a considerable Power of dissolving the softer kind of Gravel stones; and therefore ought to be preferred to most other Vegetables for the Diet of calculous Persons. Vide *Hales's Staticks*, Vol. 2. and *Rutty's Experiments on Mrs. Stephen's Medicines*.

47. I digested a Piece of the same *Calculus* of four Grains in a Solution of *Nitre* in Oister Lime-water, in the above Proportion, which, in five Days and twelve Hours, had near one Grain of its Substance dissolved.

48. Having immersed a Fragment of *B*, seven Grains, in Oister Lime-water *Unc.* iii. *Sal Cathart. amar. drach.* i.; after near four Days warm Digestion, the *Calculus* had scarcely lost any of its Weight, but its external Surface was softer, and somewhat rotten.

49. At the same time I put a Piece of *B.* six Grains, in Oister Lime-water *Unc.* ii. in which was dissolved *Sal Glauber. scrup.* ii; after being kept near four Days in a moderate Heat, its Surface was rather more rotten than the *Calculus* in the last Experiment, but it had lost none of its Weight.

50. A Piece of *B*, six Grains, by digesting warm in Oister Lime-water *Unc.* iii. *Sea Salt drach.* i. betwixt three and four Days. had a Grain of its Weight dissolved.

Lime-water does not remarkably dissolve most of the above Salts, for the greatest part of them, after standing a little, falls to the Bottom; upon which account I kept the *Calculus* in these Experiments suspended in the Middle of the Phial by a Thread.

Hence

Hence we see, that Salts, even those of the neutral Kind, destroy considerably the Virtue of Lime-water.

51. I put a Piece of *B*, four Grains, in a Solution of seven Grains of *Aloes*, in Oister Lime-water *Unc.* ii.; which, by thirty six Hours warm Digestion, was reduced to about three Grains.

52. I infused *Pulv. Rhæi gr. x.* in Oister Lime-water *Unc.* iii. for twelve Hours; after which I immersed in it a Piece of *B*, six Grains; in thirty two Hours warm Digestion, near two Grains of it were rotten and dissolved.

It is observable that Lime-water, mixed with Powder of Rhubarb, immediately acquires a deep red Colour, as if Cochineal had been infused in it; and the same thing happens when an Infusion of Rhubarb is mixed with stale Urine or Potash; whence we may see why the Urine of a Person who has taken Rhubarb acquires a bloody Colour if it remains but ever so short a time in a Pot, which is crufted with the Sediment of stale Urine. A *Phænomenon*, which, doubtless, has discomposed not a few who were ignorant of its true Cause.

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53. Having

53. Having infused in the same manner *Pulv. Jalap. gr. x.* in Oister Lime-water *Unc. ii.* I put in a Fragment of *B*, six Grains, which, by digesting warm thirty two Hours, was reduced to five Grains.

54. A Piece of *B*, four Grains and a half, being for thirty four Hours digested warm, in an Infusion of *Senna drach. sem.* in Oister Lime-water *Unc. iii.* lost one Grain.

55. Having dissolved *Manna scrup. ii.* in Oister Lime-water *Unc. ii.* I immersed in it a Piece of *B*, four Grains and a half; which, by being kept thirty four Hours in a moderate Heat, had above a Grain of its Substance rotten and dissolved.

From these Experiments we see, that if, by drinking Lime-water, the Body should be rendered costive which (especially if no Soap is taken along with it) may sometimes be the Case, it will be better to use some of the last mentioned Purgatives, than any of the Salts in the Beginning of this Section.

S E C T. IX.

Experiments shewing the Change made on Lime-water by boiling, and being exposed to the open Air; with further Observations on its Nature and Use in several Diseases.

HAVING in the above Sections made a Variety of Experiments with Lime-water upon different Substances, it seemed next very proper to try what Alteration would happen to it from boiling, or exposing it to the open Air, and to enquire wherein its Virtue consists.

56. Twelve Ounces of Lime-water being boiled pretty quickly into four, had lost some of its Virtue; for whereas, before boiling, a blackish Colour was produced by two Parts of it to one of Claret, now it required near two and a half. Nay Dr. *Langrish* tells us, that upon distilling a Pint of Lime-water from two Quarts, he found both the distilled Water in the Receiver, and what remained in the Retort, impaired in their Virtues*.

The Vapour that arises from hot Water during its Ebullition with Quick-lime, is only

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* *Physical Experiments on Brutes*, p. 13, 15 and 16.

an insipid and inodorous Water, quite destitute of any of the Virtues of Lime*.

57. If a Bottle be filled with Lime-water, and closely stopp'd, it will keep for a long time, without suffering the least Change, or losing any of its Virtues: But, having expos'd four Ounces of it in an open Vessel, it began very soon to throw up a Scum, and let fall some Sediment of the same Nature; in three Days it had lost most of its fiery Taste, and ceased to turn Claret blackish; and in five Days, when the Taste of the Lime was almost quite gone, it neither changed the Colour of Syrup of Violets, nor had any Effect in dissolving the Stone. And this happens equally soon, when placed in the cold Air, as in a moderate Heat; but depends a great deal upon the Narrowness or Wideness of the Vessel: For it will be found, that the Time in which Lime-water, thus expos'd, loses its Virtue, will be more or less, according to the Proportion which the Surface bears to the Quantity of the Fluid.

Since Lime-water, when thus expos'd, continues to change the Colour of Syrup of Violets near two Days after it has ceased to
have

* Physical Experiments on Brutes, p. 13 and 14.

have any Effect upon Claret, this last seems to be the severest Test of its Goodness.

The Scum which Lime-water, exposed to the Air, thows up, is at first an extremely thin Pellicle, exhibiting various Colours like a Rainbow, or Soap Bubble; these Colours, however, gradually change, till, by the constant Apposition of new Particles, the Scum becomes thick enough to reflect all the Rays of Light equally, and so appears white.

This icy Scum or Crust which Lime-water affords, being well beat, and mixed with Syrup of Violets, and then some common Water added to it, the Mixture, after a little standing, acquires a green Colour. The Parts of this Scum are so minutely divided, and intimately mixed with the Water when it is first poured off the Lime, as to be absolutely invisible, and to remain inseparable from it, as long as it is kept in a close Vessel. Why they should immediately begin to separate from the Water, and unite together when exposed to the open Air, may perhaps not be easy to account for. But is not Lime-water rendered weaker by boiling, because its Parts are thus more exposed to the Air, and not by the Heat's expelling any thing out of it? And does not Lime-water, when distilled in close

Vessels, lose some of its Virtue, because its Parts, when elevated in the Form of a Vapour, are more exposed to the Action of the Air in the Retort and Receiver? Is not this rendered probable by Dr. Black's Observation, viz. That tho' *Magnesia Alba*, which abounds with Air, destroys the Virtues of Quick-lime and its Water, yet, after it is deprived of its latent Air by Calcination, it has no such Effect*?

Here it may be worth while to observe a considerable Analogy between some Mineral Waters and Lime-water. Chalybeat Waters are, when exposed to the Air, observed soon to let fall a yellow Ocre, and lose their Virtues; and Lime-water, exposed in the same manner, soon throws up an earthy Scum, and becomes effete.—Lime-water, boiled in open Vessels, or distilled in close ones, loses a good deal of its Strength, and the same thing is still more remarkable in mineral Waters.

It has been a common Opinion, that while the martial Spirit (as it is called) remains in Chalybeat Waters, their metallic Particles continue invisible, but that no sooner does this Spirit fly off, than these Particles begin to unite

* *Dissertatio inauguralis, de Magnesia Alba.* p. 31, 32, 33, and 37.

nite and shew themselves in the Form of a yellow Ocre. Is it probable then, that when Lime-water is exposed to the Air, it soon becomes deprived of some active volatile Matter, which kept its earthy Particles from uniting, and to which its Virtues were in a great measure owing? or rather may not the Air in some other way, destroy the Virtue of Lime-water?

The calcarious Matter which separates from Lime-water upon its being exposed to the Air, can by no Art be again dissolved in Water, or intimately united with its Particles, but perpetually falls to the Bottom, in the Form of a white Powder; which is altogether insipid, and void of Taste. And upon this account, I suppose, it has generally been looked upon as a fine flaked Lime; though, from the following Experiments, it will appear, that it differs both from flaked and un-flaked Lime.

(1.) Calcined Shells fresh from the Fire, make but a small Ebullition with Vinegar, and send forth a disagreeable sulphureous Smell.

(2.) Calcined Shells that had lain in Water till they were thoroughly flaked, when dried, and reduced to a Powder, did not effervesce with Vinegar at all.

(3.) The

(3.) The calcarious Matter afforded by Lime-water upon Evaporation, being mixed with Vinegar, a strong Ebullition ensues, which lasts for a considerable Time.

(4.) I put a small Quantity of this Powder of Lime-water in a Silver Spoon, and kept it over a pretty brisk Fire for fifteen Minutes; but after it was taken from the Fire, and cooled, it raised the same Effervescence with Vinegar as before.

(5.) I poured boiling Water once and again upon some of this calcarious Matter, to see if, by repeated *Affusions* of the Water, it would lose any thing; but, after the Water was drained off, and the Powder moderately dried, it effervesced with Vinegar equally as before.

Hence the Ebullition which the calcarious Matter of Lime-water makes with Acids, seems neither to be owing to a volatile nor fixed alkaline Salt; for a volatile Salt would have been expelled by the Fire, and either a fixed or volatile one dissolved by repeated *Affusions* of boiling Water.

(6.) Powdered Chalk makes a considerable and lasting Ebullition with Vinegar in the same manner as the Scum of Lime-water, and continues to do so, after repeated *Affusions* of boiling

boiling Water, or being exposed to the Heat of a brisk Fire.

Hence the calcarious Matter afforded by Lime-water seems to be a true *alkali terreux*, like Chalk, and its Effervescence with Acids to be owing to this alone.

(7.) Although Quick-lime makes but an inconsiderable Ebullition with Vinegar, and slaked Lime none at all, while the calcarious Matter of Lime-water makes a strong and lasting one; yet all three raise a prodigious Effervescence when mixed with the stronger Acids, as Spirit of Nitre, or Spirit of Sea-Salt. Hence all of them seem to partake a good deal of the *alkali terreux*, although this is strongest in the Scum of Lime-water.

58. Lime-water, when mixed with Vinegar, in the Proportion of ten to one, does not throw up any Scum; but when it has all evaporated in a moderate Heat, leaves a dark-coloured Sediment; which seems however chiefly to arise from the Vinegar.

59. It has generally been thought, that no Salt could be got from Lime-water: nor could I by evaporating it ever procure any; the Scum left behind having rather the Appearance of a fine Lime, or absorbent Earth. If it be said, the Salt in Lime-water is of the volatile kind,
and

and therefore not to be got by Evaporation, it may be sufficient to answer, that, then this volatile Salt which should in some degree affect our Smell, ought to be procured by distilling Lime-water in close Vessels: But it is so far from being true, that there is any volatile Salt in Lime-water, that the Vapour which rises from Water during its Ebullition with Quick-lime, is entirely devoid of the Virtues of Lime, and scarcely differs from Common-water. Yet upon adding one Part White-wine Vinegar to ten or twelve Parts Stone Lime-water, after some Days, I perceived some saline Concretions adhering to the Sides of the Glass: These tasted not unlike Sea-salt, but sweeter, and, no doubt, proceeded from the acid Salt of the Vinegar rendered neutral by the Lime-water. Having infused a Fragment of *B* in some Oyster Lime-water, made with Shells that had lain fifteen Hours after being taken from the Fire, I was surpris'd to observe, in three or four Days, a prodigious Number of small pointed-Chrystallisations, like fine Needles, about the sixth Part of an Inch long, darting as it were into its Surface, and giving it somewhat the Appearance of a Hedgehog. But I am apt to think, that these did not proceed from the Lime-water, but the Sea-salt, with which the

Oyster-shells

Oister-shells, even after Calcination, so much abound *. And accordingly I have since often observed the same saline Chrystallisations, tho' not so remarkable, produced by Lime-water made with Oister-shells newly got from the Sea; although as far as I remember, never from Stone Lime-water, nor that made with calcined Shells, which, by being long exposed to the Weather, had been entirely deprived of their Sea-salt. We are told indeed, that Mr. *Lewenhoeck* discovered, by his Microscopes, in Lime-water, a great Number of saline rigid particles †. But whether his Imagination assisted him herein, or whether he did not rather want to discover a Similitude betwixt this Water and that got off burnt *calculi*, and the tophaceous Matter which sometimes issues from the Joints of gouty Persons; or whether there really are such saline Particles, I will not take upon me to determine: For altho' it has been the general Opinion of the most eminent Chymists, that no Salt could be procured from Quick-lime; yet, of late, Mr. *Du Fay* ‡ pretends to have extracted a Salt from Lime-water, and has given an Account at large

* See No. 67. below.

† Musgrave de Arthritide, cap. ix. § 4.

‡ Memoires de l'Acad. des Sciences 1724.

large of the Way in which this may be done. But, since his Salt is of the neutral kind, and does not seem to be possessed of any remarkable Virtues; and since he observes, that, unless the Lime-stone is put red hot into the Water, and boiled with it, and its Water poured out while it is yet boiling in order for Evaporation, it either affords no Salt at all, or very little; we may safely conclude, that the Virtue of Lime-water does not lie in this Salt. And as the calcarious Substance which, upon Evaporation, it deposites, has little or no Efficacy, and seems scarcely any thing different from a mere absorbent alkaline Earth; it remains, that the dissolving Virtue of Lime-water is owing to some more active Principle which the Water, during its Ebullition with the Quick-lime, is impregnated with, and to which the Increase of its specifick Gravity is partly to be ascribed; but which, upon Lime-water's being exposed to the Air, either soon flies off, or is destroyed.

60. Altho' Lime-water changes the blue Colour of Syrup of Violets into green, and affords an alkaline absorbent Earth, which effervesces with, and destroys Acids; yet as the Water itself does not effervesce with Vinegar or Spirit of Vitriol, it seems to partake but little

tle of an alkaline Nature. Nor do the Virtues of Quick lime consist in an *Alkali*: For Quick-lime effervesces much, less with Vinegar than with Small-beer, and is very difficultly flaked by either; while Water, which is neither acid nor *alkali*, being poured upon it, produces great Ebullition and Heat, and quickly dissolves it. And altho' Quick lime makes a great Ebullition with the stronger Acids, as Spirit of Vitriol, Nitre, and Sea-salt; yet this arises from the terrestrious *Alkali* which it contains in common with flaked Lime, the Scum of Lime-water, and the other Absorbents, and not from any particular Salt of that Nature. Nor is the Activity and corrosive Power of Quick-lime owing to its alkaline Nature; since the calcarious Matter of Lime-water, which is insipid, and altogether void of the peculiar Taste of the Lime, makes a greater Effervescence with Vinegar than it, and since Mr. *Homburg* has observed that flaked Lime requires as much Spirit of Nitre, or Sea-salt to saturate it as Quick-lime*.

The drinking of Lime-water does not render the Urine alkaline; for Mr. *Millar's* Urine neither effervesced with Vinegar, nor turned Syrup of Violets green; altho' he alledged

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* Memoires de l'Acad. des Sciences an. 1700.

he could perceive the Taste of the Lime-water in it. Nor does Quick-lime itself change any of the Humors of our Body into an alkaline Nature. Upon adding it, indeed, to Urine, a fiery pungent Vapour arises; which, however, is not properly alkaline; for being mixed with Acids, no Effervescence ensues, though its fiery Nature and Volatility are greatly diminished by them. Nor has any Art, yet, been able to procure from this Spirit the smallest Quantity of Alkaline, or indeed of any other Salt*.

From this it is evident, that the strong-scented alkaline Urine voided by such Persons as have taken Mrs. *Stephens's* Medicines, is not so much owing to the Lime in them, as to the alkaline Salt or Potash, which makes up so considerable a Part of the Soap. And the dissolving Virtue of such Urine does not seem to consist (as Dr. *Kirkpatrick* and the *French* Academists think †) in its alkaline Nature; since we find in Mr. *Millar's* Urine this Power without that Quality; and since Dr. *Hales* has shown, that the Potash, which is almost the

* Boerhaave *Chemia*, Vol. 2. *Proces.* 97.

† *Kirkpatrick's Case*, and *Memoires de l'Acad. des sciences*, an. 1739 & 1740.

the only alkaline Ingredient in these Medicines, has little Effect in dissolving the Stone.

(*m*)

Altho' Quick-lime appears, by its Effects, to have a very considerable Affinity with fixed alkaline Salts, yet in many respects it differs from them; and there are not wanting Experiments which seem to indicate an acid Quality in it. Hence several chymical Writers have been of opinion, that Quick-lime contained both an acid and a fixed alkaline Salt, and to the Conflict between these opposite Salts they have ascribed the Ebullition and Heat which is produced when Quick-lime is dissolved by pouring Water upon it (*n*). Nor is it any wonder, say they, that, by the Affusion of Water, no Salt is got from Quick-lime, because its two opposite Salts are, by acting on each other, destroyed, and turned into a third Substance, which, like all Magisteries, is insipid, and not dissolvable in Water (*o*).

Lime-water being mixed with Salt of Tartar, immediately becomes turbid and whitish, and after some time lets fall a white insipid

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Powder,

(*m*) See below. No. 62.

(*n*) Mayow oper. cap 14. de æstu calcis vivæ.

(*o*) Idem Ibid.

Powder, which is not a vitriolated Tartar, as has been imagined, (*p*) but greatly resembles prepared Oyster or Egg Shells, and the Crusts of Lime-water *; for it is an absorbent alkaline

(*p*) Macquer *elemens de chymie theorique* p. 67.

* I had said, (*Edinburgh Physical Essays*, Vol. I. Art. xiii.) that the Precipitation which happens upon mixing Salt of Tartar with Lime-water, is almost wholly from the Water and not from the Salt. This has occasioned some Remarks by Dr. *Alston* *, who having, in the first Edition of his Dissertation on Quick-lime, affirmed, That this Precipitation was chiefly from the alkaline Salt; thought himself obliged, it would seem, to overthrow a Position so inconsistent with his own. But that it may appear, what Ground the Dr. had for attacking me on this Quarter, I shall shortly produce my Reasons for thinking that the Powder precipitated by mixing Salt of Tartar with Lime-water, is no other than the calcarious Earth which was before contained in the Water.

1. The calcarious Matter precipitated by mixing Salt of Tartar and Lime water, is in proportion to the Quantity and Strength of the Lime-water, but not of the Salt.

2. Soap Leys mixed with Lime-water, produce the same Precipitation as Salt of Tartar, or a Solution of it in common Water: But it is by no means probable, that the Salt in the Soap Leys which has before sustained the Action of Quick-lime without being converted into an earthy Powder, will suffer this Change by the much weaker Action of Lime-water.

3. If the white Powder precipitated upon mixing Salt of Tartar with Lime-water, proceeded from the Salt, a Solution of this Salt in Water should be rendered turbid and

* Dissertation on Quick lime. 2d. Edit. p. 64.

caline Earth which effervesces strongly with Vinegar and Spirit of Vitriol, but is not dissolved by the latter. When 30 Grains of

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Salt

and milky, and produce a greater Precipitation, by having a Piece of calcined Oister-shell immersed in it, than by being mixed with Lime-water; which however is not the Case. For having dissolved a Dram and a half of Salt of Tartar in something more than two Ounces of Water, and filtrated the Solution thro' gray Paper, I immersed in it three or four Pieces of calcined Oister Shells, weighing about two Drams, a hissing Noise immediately ensued, and a good many Air Bubbles arose, but the Liquor remained equally pellucid as before; nor was there any turbid milky appearance in this Ley, during four Days that it stood on the Lime, and scarce any *observable* Precipitation of the Salt; I say observable, because it was not easy to distinguish a small Precipitation, from the Lime-powder, a little of which fell from the Shells to the Bottom of the Glass.

4. But supposing that Quick-lime precipitates $\frac{1}{23}$ Part of Salt of Tartar or Potash, when a Solution of these Salts is poured on it in order to make Soap Leys, as Dr. *Alston's* Experiments shew*; then, altho' Lime-water could precipitate the same Proportion of the alkaline Salt mixed with it, yet only $1\frac{1}{3}$ Grain of the Powder precipitated by mixing 30 Grains of Salt of Tartar with twelve Ounces of Oister Shell-lime Water could proceed from the Salt, while above eleven Grains must be derived from the calcarious Matter in the Water. But if Lime-water does not precipitate near so much of the Salt as Quick-lime, the Quantity of the precipitated Powder arising from the Salt of Tartar must be greatly less, very probably not $\frac{1}{10}$ of a Grain more, than that very small Proportion of this Salt which is turned into Earth, when it is dissolved in common Water.

5. When

* Dissertation on Quick-lime, p. 1.

of Tartar are mixed with 12 Ounces of Lime-water, the Mixture continues to taste both of the Lime and alkaline Salt, and this equally after the above mentioned Powder has fallen to the Bottom of the Vessel, as before. If the Lime-water be very strong, or if more of it be added to the Salt of Tartar, the Mixture will taste much more of the Lime than of the Salt.

When

5. When two or three Drops of Lime-water fall into a Solution of Potash or Salt of Tartar, they become immediately white, but this Appearance, soon after, vanishes, because so small a Quantity of Lime-water, affords too little earthy Matter to be visible when dispersed thro' the whole Solution of the Salt. If an Ounce of Lime-water mixed with Salt of Tartar, gives only a Grain of calcareous Matter, one Drop will not give $\frac{1}{300}$ Part of a Grain, which is too small to be visible, when it falls to the Bottom of the Glass in the Form of a Powder. But on the other hand, a few Drops of a Solution of Salt of Tartar or Potash, let fall into a Glass full of Lime-water, render the whole turbid and milky, and precipitate a white Powder, because a very little of the Solution is sufficient to separate a considerable Quantity of calcareous Matter from the Water.

These Experiments, therefore, are so far from shewing that the Precipitation in question is chiefly from the alkaline Salt *, that, when viewed in a just Light, they clearly demonstrate the contrary; and thus overthrow the Opinion they were adduced to confirm.

* Dr. Aston's Dissertation on Quick-lime, p. 18. 19.

When Lime-water destroys Acids, we readily ascribe this Effect to the alkaline Earth which it contains: But to what Principle in Lime or Lime-water are we to refer the Precipitation which happens upon the Mixture of Lime-water with a fixed alkaline Salt? Does it shew that there is an Acid in Lime-water? that this Acid is united closely with an alkaline Earth, which it keeps invisibly suspended in the Water; but that being strongly attracted by the fixed alkaline Salt, it leaves this Earth, which then precipitates in the Form of a white Powder? Are we to ascribe it to this Acid, that Spirit of *Sal Ammon.* distilled with Quick-lime, has its Nature so changed, as not to effervesce with Acids? Does it seem probable, that certain Stones and Animal Shells are, by Calcination, changed into Quick-lime, because, as alkaline Earths, they are peculiarly qualified to receive and unite with this Acid? And may we conclude from the above Experiment, that the active Properties of Quick-lime are owing to an alkaline Earth heightened, perhaps, by the Fire, and united with a subtil acid Spirit? Whoever should answer these Queries in the Affirmative, would be greatly too hasty in his Conclusions; for the following Experiment will shew, that though
fixed

fixed alkaline Salts render Lime-water turbid, and cause a Precipitation, yet their alkaline Quality is not destroyed by it.

Having added forty Grains of Salt of Tartar to twenty Ounces of strong Stone Lime-water, after some Hours, I poured off the clear Water; and boiled it into three Ounces and a half; when it effervesced strongly, both with Vinegar and Spirit of Vitriol. Further, if there was an Acid in Quick-lime, would a Solution of Potash have its pungent corrosive Qualities greatly heightened by being poured upon it? Ought not rather its alkaline Nature to be thence greatly impaired or destroyed?

Mr. *Geoffroy* thinks, that there is in Quick-lime a fixed alkaline Salt, formed of the aluminous, vitriolick, or nitrous Acid of the Stone, and of the Acid in the Wood or Coals (*q*). This Salt he imagines to be, like the fixed *alkali*, united with Flint and Sand in making Glass, so intimately conjoined with the earthy Parts of the Lime, as not to be separable from them by any Affusion of Water. But if this be so, it must be allowed that Lime-water cannot owe its Virtues to this Salt; nor by consequence

(*q*) *Memoires de l'Acad. des Sciences* 1720, Edit. 8vo, p. 28.

sequence Lime itself, whose Virtues are of the same kind, tho' vastly stronger. If it be said that Lime-water contains some of the finer Parts of the Lime, to which its Virtues are owing; we answer, that as the calcarious Matter which Lime-water affords, is a mere alkaline Earth, the supposed Salt must have left it, and consequently cannot be so inseparably united with the earthy Parts of the Lime, as is supposed. Further, as Quick-lime, after being rendered insipid by frequent Affusions of Water, acquires its former Properties, by a new Calcination (*r*), it evidently follows, that no peculiar Salts are required in animal Shells, Stones, or Chalk, in order to their being changed into Quick-lime by Calcination.

Nay, if Lime stone be, before Calcination, impregnated with alkaline, acid, or neutral Salts, it will not, by being burnt in the most intense Fire, acquire the Properties of Quick-lime (*s*). And hence we may see, why Quick-lime, whose Virtues have been extracted by a Ley of an alkaline Salt, does not become Quick-lime again by a new Calcination.

Since

(*r*) *Memoires de l'Acad. des Sciences* 1700, Edit. 8vo, p. 160. et *Macquer elemens de chemie theorique*, p. 66.

(*s*) *Macquer elemens de chemie theorique*, p. 68. &c.

Since then, there deos not appear any good Reason to ascribe the Virtues of Quick-lime or Lime-water to any acid or alkaline Salts ; it may be asked, what is the Nature of Quick-lime, and whence do its active Qualities proceed? To which I answer, that it is an alkaline Earth, which acquires, by Calcination, highly acrid, penetrating and igneous Properties ; and that, as the native Salts of Vegetables are, by the Action of the Fire, converted into a fixed alkaline Nature, so the earthy Matter of animal Shells, and certain Stones, is, by burning, changed into an active fiery Substance, which, however it may agree in some things, with these Salts, differs from them in many Respects, and is of a Nature peculiar to itself.

Whether the active Properties of Quick-lime are owing to the Element of Fire, being closely united with, and as it were concentrated in its earthy Matter ; or whether they are not rather to be ascribed to some new Change made on this Matter by the Action of Fire, I shall not pretend to determine : Only, as Air is attracted by the Bodies of Animals and Vegetables in considerable Quantities, and deprived of its Elasticity, while intimately united with their minute
Parts :

Parts : (t) So, may not the Particles of Fire be received into Lime stone and Shells, while they are calcining; and there remain, as it were, fixed and unactive, till they are set loose by the Dissolution of the Parts of the Lime, upon the Affusion of Water (u) or some other *Menstruum*?

Since the Difference between the specifick Gravities of Lime-water and common Water is considerably more than the Weight of the Crusts which the former throws up, or of the calcarious Powder which it precipitates by being mixed with Salt of Tartar; it is probable, that Quick-lime communicates to Water something besides this earthy Matter. But of this we are fully convinced, by observing, that
after

(t) Hales Statical Essays, Vol. I. chap. 6.

(u) This was Doctor Willis's Opinion, who thence explained the Ebullition, which happens when Water is poured on Quick lime; but it must be owned that, for aught we know, this Ebullition may be, in a great measure, owing to the entire Expulsion of all Humidity out of the Lime stone and Shells by Calcination; for when boiling Water is poured on Coffee-beans, fresh burnt and ground, a like Ebullition ensues; which, however, can with no Colour of Reason, be ascribed to any concentrated Fire; and the same thing is true of the violent Ebullition and Heat, that are occasioned by the Mixture of Water and Oil of Vitriol.

after twelve Ounces of double Lime-water had, by being mixed with 30 Grains of Salt of Tartar, precipitated near 16 Grains of earthy Powder, it tasted almost as strong of the Lime as before its Mixture with the alkaline Salt; yet, by adding more Salt of Tartar to it, I found that it did not contain above one Grain more of the earthy Part of the Lime. Now since the calcarious Matter of Lime-water is perfectly insipid and void of any other Virtue, than what all absorbent Earths possess, it follows, that not only the peculiar Taste of Lime-water, but also its most conspicuous Virtues, particularly that of dissolving the *Stone*, are owing to some subtile active Principle, which is strongly attracted by alkaline Salts, and thus separated from the calcarious Matter with which it was before closely united. This subtile Principle of Lime-water is so strongly embraced by alkaline Salts, that it is not lost, or changed in its Nature by Exposition to the Air, which, however, happens when pure Lime-water is exposed for some Days in an open wide-mouthed Vessel.

Since alkaline Salts, while they unite with the more subtile Part of Lime-water quickly precipitate its earthy Matter, is it not highly probable

probable, that a Solution of these Salts poured on Quick-lime, will strongly attract and unite with its more subtile Part, but refuse to take up any, or *almost* any, of its proper terrestrious Matter? And is not this confirmed by Dr. *Alston's* Experiments, which shew that Quick lime, upon which a Solution of Potash was poured, instead of losing, acquired an Addition of Weight *? My Friend has further observed, That Quick-lime which has been used in making Soap-leys, gives afterwards little or no Virtue to Water†; this, however, does not happen, because it is so fixed by the alkaline Salt, as afterwards not to yield its Virtues to Water, but because the alkaline Solution has almost wholly deprived the terrestrious Part of the Lime of that active Principle, to which its peculiar Taste, Acrimony, and Power of dissolving the Stone, are owing.

From this Account of the Action of alkaline Salts on Quick-lime, we may see why Soap-leys, or a Ley of Potash and Quick-lime, is a much more powerful Solvent of the Stone than Lime-water; for while this last contains no more of the active Matter of

I

Quick-lime

* Dissertation on Quick-lime, p. 17. † Ibid p. 18.

Quick-lime than is united with that very small Portion of its earthy Part which Water can take up; the former consists of a vastly greater Proportion of this active Principle separated from the earthy Part of the Lime, and united with an acrid Salt. It also, hence, appears why the *Lapis infernalis* is more corrosive than Quick-lime itself. In Quick-lime the active Principle is united with an insipid Earth; in the *Lapis infernalis* it is joined to an acrid fiery Salt.

But if this Account of the Constitution of Soap-leys be true, it may be thought that there should be no earthy Matter at all in them; and indeed the Quantity of this is so small, that Mr. *Geoffroy* makes no mention of any calcarious Matter in his Analysis of Soap*. Dr. *Hales*, however, having dissolved 320 Grains of the *Lapis infernalis* or dry Salt of Soap-leys, in hot Water, and filtrated the *Lixivium* through Paper, found 11 Grains of earthy Matter, *i. e.* $\frac{1}{29}$ Part of the whole †; which is about four times as much as 320 Grains of pure Potash would have afforded if it had been treated in the same Manner. But as the remarkable Vir-

tues -

* *Memoir. Acad. des Sciences*, an. 1739.

† *Experiments on Mrs. Stephen's Medicines*, p. 8.

tues of 320 Grains of *Lapis infernalis* cannot be owing to so few Grains of Quick-lime united with its alkaline Salt, so it seems certain, that this Salt must receive something else from Quick-lime; and is it not probable, that even this small Quantity of Earth proceeded, either from the Impurity of the Ley used by Dr. Hales, from the Vessel in which it was evaporated, or from the alkaline Salt *

I 2

which

* I evaporated away in a white stone Bason, over a very slow fire, about four Ounces of a Ley of purified Potash and Quick lime, which I had kept in a corked Bottle two Years and a half; and obtained from it 234 Grains of a dry white Salt, which being carefully dissolved in six Ounces of cold Water, and filtered through grey Paper, yielded no more earthy Matter, than the same Quantity of a pure alkaline Salt would have done if treated in the same Manner. Not satisfied with this, I poured 14 Ounces of Water upon three Ounces of common Potash, and five Ounces of Oister Shell-lime that had been infused in Water for 14 Days. Having frequently stirred this Mixture, I decanted off some of the clear Ley after it had stood ten Hours on the Lime; and having evaporated it as above, I dissolved 124 Grains of the dry Salt in boiling Water and filtered it, the Matter which remained in the filtering Paper feeling very smooth and oily, I mixed it well with some cold Water, and filtered it again, when there scarce remained $1\frac{1}{4}$ Grain of earthy Matter, *i. e.* very little more than a pure alkaline Salt would have afforded.

At another time I evaporated away, in a brown glazed earthen Vessel, some of the first mentioned Ley of Potash and Oister Shell-lime, and obtained 174 Grains of a dark brown coloured Salt, which being dissolved in cold Water
and

which, by the Action of the Quick-lime upon it, may perhaps be rendered more easily convertible into Earth, than it was in its natural State? And does not this seem to be confirmed by those Experiments which shew, that when equal Parts of Quick-lime and Potash are infused in Water, $\frac{1}{23}$ Part more of the Latter is converted into Earth than would have been by dissolving it in Water alone †?

Upon the whole, since Lime deprived of its Virtues, and the calcarious Crufts thrown up by Lime-water, may, by a new Calcination, be converted again into Quick-lime ; is it not probable, that what Lime-stone, Chalk and Shells receive from the Fire, is that active Principle which gives to Quick-lime and Lime-water their peculiar Taste and most remarkable Virtues, and which is strongly attracted by alkaline Salts, while the earthy Part of Quick-lime is rejected by them ?

61. From

and filtered, left in the filtering Paper six Grains of a brown earthy Sediment.

These Experiments seem to shew (contrary to what some have thought *,) That pure Soap-leys contain very little, or rather none of the earthy Part of the Lime; and that when they have afforded a greater Quantity of calcarious Matter, it may perhaps have been owing to the Vessel in which they were evaporated.

* Dr. *Alston's* Dissertation, Edit. 2d. p. 19. 72.

† Dissertation on Quick-lime. p. 17.

61. From the great Affinity which has been generally supposed, by medical Writers, betwixt the Gout and Gravel, it might perhaps be worth while to try the Effects of Lime-water in this Disease also. And the learned Dr. *Cheyne* having asserted, that the gouty Chalk-stones were, as to their essential Qualities, the same with Gravel-stones, and that they yielded both the same Principles, when chymically treated (*x*), I procured some of the former, and infused them in Lime-water. At first, being specifically lighter than the Water, they swimm'd. But, after emitting a great Number of Air-bubbles, they soon fell to the Bottom, and, in a Day or two, were become as soft as Butter. But, having afterwards infused a Piece of this gouty Matter in Common Water, I found precisely the same Effects from it as from the Lime-water: So that whatever Probability there may be of Lime-water doing Service to gouty People, from the supposed Affinity betwixt it and the Gravel, yet nothing can be drawn from this Experiment. However, Lime-water promises to do as much, as an Alterative, in several chronical Diseases, as many other Medicines. It may be taken in large Quantities,

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and

(*x*) *Cheyne* on the Gout, p. 72. Edit. 4.

and be long persisted in. Its Parts are so subtile, that they can penetrate, at least, where-ever Water can go (y); and consequently, must pass thro' the smallest Vessels in the human Body. When mixed with the Blood or Urine, it seems to exalt their Salts and Oils, and upon the Solids it acts partly as an Astringent. Hence it ought to be of use where the Blood is watery, sluggish, viscid, and unactive, and the Solids weak or relaxed. In the *Fluor Albus* and *Diabetes* its Virtues are conspicuous; and it promises to do more in the *Scrophula* than most Medicines. In *Diarrhæas* and *Dysenteries* from Acidities in the *Primæ Viæ*, and in Excoriations, or Ulcerations of the Guts, it is an excellent Remedy. From its penetrating, dissolving (z) and detergent Qualities, there is Reason to expect Benefit from its Use in chronick Rheumatisms, the *Sciatica* and other Obstructions in the smaller

(y) See No. 57, above.

(z) It has been observed, that when *Ichthyocola* is dissolved by boiling it in Lime-water, it loses its glutinous Quality; and sily Blood let from a Vein into a Cup half full of tepid Lime-water, has its Crust somewhat thinner and less tough, than when it is mixed in the same Manner with common Water. Is it not hence probable, that Lime-water may be of use where the Stomach is loaded with a viscid Phlegm, or the Blood infected with a cold *Lentor*?

ler Vessels. I have been told of its having had good Effects in low nervous Fevers: But in ardent and putrid Fevers it ought to be hurtful, on account of its Power of volatilising the Salts, and corrupting the Oils of the animal Humours. In those cutaneous Eruptions, which are commonly but improperly termed scorbutick, it sometimes proves a sovereign Remedy, at other times fails. I once cured a wet scorbutick Eruption on the Hands, after a mercurial Salivation had been found ineffectual, by causing the Patient drink above an *English* Pint of Oyster-shell Lime-water every Day for two Months, and now and then wash her Hands with it.

SECT. X.

Experiments with Lime - water, Soap-leys, Soap, &c.

As it appears from Dr. *Hales's* Experiments, that Soap is possessed of a considerable Power of dissolving the Stone, and that this is chiefly owing to the Lime that enters into its Composition, I was excited to make some Experiments upon it, with a view still further to discover wherein its Virtue lay, and what

what Proportion it bears to that of Lime-water; whether Lime-water might not be improved by it; and how far their lithontrip-tick Quality is destroyed by the same Things.

62. Having dissolved Potash *drach. ii. sem.* in boiling Water *Unc. iv.* I put in it a Piece of *A*, weighing nine Grains, which, in fifteen Days warm Digestion, lost very little of its Weight, nor was its Surface softened to any Depth. However, its Substance seemed to have been rendered more friable; for, upon pouring boiling Water upon it, it rent in several Places.

63. I boiled Stone Lime-water *Unc. xiv.* with Potash *drach. v.* into *Unc. vi.* and having laid a Piece of *A*, of eleven Grains and a half, in it, found, that after standing twelve Days in a gentle Heat, it had lost seven Grains and a half of its Weight.

64. A Pound and a half of boiling Water, in which an Ounce of Potash was dissolved, being poured on two and a half Ounces of Quick-lime, afforded, after the Ebullition was over, and the Lime had fallen to the Bottom, a very fiery corrosive Liquor; which, if applied to the Tongue, in the smallest Quantity, was in hazard of bringing off the Skin. A Piece of *A*, ten Grains and a half, was dissolved

dissolved in it in fifteen or sixteen Hours, in a moderate Heat. A *Lixivium* of the same kind, which I made afterwards, but which did not seem so strong, dissolved a Piece of *B*, three Grains, in twelve Hours; while a Fragment of the same *Calculus*, of fourteen Grains, required three Days and six Hours of a cold Maceration in *Aqua fortis simplex* (a) to dissolve it.

The great dissolving Power of this *Lixivium* must be ascribed to the active Principle of the Quick-lime, which is united with the alkaline Salt; for a Ley of Potash has little or no Effect on the Stone. Sir *Isaac Newton* has found, That the Particles of Light are most strongly attracted by sulphureous Bodies; and we have observed that the active and perhaps fiery Part of Quick-lime, is most strongly attracted and embraced by alkaline Salts, which are like Quick-lime the Production of Fire, and receive their acrid fiery Quality from it.

Instead of an Ounce I dissolved *drach. ii.* of Potash in *lib. i. sem.* of Water, and poured it on Quick lime as above, thinking that the *Lixivium* thus procured, would be possessed of a greater Power of dissolving the Stone than simple Lime-water, and at the same time not
so

* Pharmacop. Edinburgens.

so acrid as to be in danger of destroying any Parts of the human Body ; but I soon found that any Advantage I expected from the greater lithontriptick Virtue of this *Lixivium*, was more than balanced by the extreme Nauseousness communicated to it by the alkaline Salt.

64. Having found a much greater Power of dissolving the *Calculus* in Shell than in Stone Lime-water (*b*), I thought it worth while to try whether a Ley made with Shell-lime and Potash, would prove a stronger Lithontriptick than common Soap-leys. For this Purpose I poured two Pounds of boiling Water upon four Ounces of purified Potash, and five Ounces of calcined Oyster-shells fresh from the Fire, and let them stand twenty four Hours. Then into a Phial-glass filled with this Ley, I put a Piece of *B*, thirteen Grains, which, after ten Hours warm Infusion, was intirely dissolved. At the same time I put another Piece of *B*, of the same Weight, into the common Ley with which they make Soap at *Glasgow*. After sixteen Hours warm Infusion, it was mostly all dissolved into a white Powder ; and the very small *Nucleus* that remained, was quite rotten, and,

when

(*b*) See above, No. 14. 18.

when pressed between one's Fingers, fell down into a white Mucilage.

This Ley, made with Oister Shell-lime, was as pellucid as Water, and neither so corrosive nor disagreeable as the *Glasgow* Soap-leys; for, when mixed with twelve times its Quantity of Water, it was less nauseous, and seemed scarcely more acrid, than the other diluted with sixteen Waters. Its specifick Gravity was about one twenty fourth Part less than that of the common Ley. Notwithstanding all which, we see its dissolving Power was above one third stronger.

Hence, in Cases where it is thought proper to order Soap-leys for the Cure of the Stone, it plainly appears, that a Ley of Potash and Shell-lime is preferable to common Soap-leys; since a larger Quantity of it may be used with equal safety, and since it possesses a much greater dissolving Power.

While the *Glasgow* Soap leys, Lime-water and a Solution of Soap, corrode, and break down the *Calculus* into a white Powder, or rotten Scales, and so are, properly speaking, only Lithontripticks, the Ley of Potash, and Oister Shell-lime melts down the Stone into an unctuous Substance, which is mostly all suspended in the Pores of the *Menstruum*; and

and therefore, like *Aqua fortis*, or Spirit of Nitre, may be properly called a Solvent of the Stone.

When a Fragment of *B* was immersed in this Ley, it immediately sent forth from every Part of its Surface small Streams, as it were of an oily Fluid, exhibiting the same Appearance in the Ley, as Rum does when mixed with Water. This may be observed by holding the Phial in which the *Calculus* and Ley are contained, between one and the Light. And though it is most remarkable after the first Immersion, yet it continues, in some degree, for a considerable Time.

The *Calculus* immersed in the *Glasgow* Ley, did not exhibit any such Appearance, but its Surface quickly became all over white.

To two Ounces of purified Potash, and three and a half Ounces of Oyster-shell Lime, I added twelve Ounces of boiling Water. After twenty four Hours, I decanted off the Ley, and poured it upon fresh calcined Shells; by which means it acquired a yet stronger Virtue of dissolving the *Calculus*: For a Piece of *B*, thirteen Grains, was, after eight Hours warm Infusion in it, totally dissolved. Although this Ley dissolved the Stone twice as fast as the *Glasgow* Soap-leys; yet, mixed
with

with equal Quantities of Water, it was less nauseous, and seemed but a little more pungent.

From these Experiments, it is reasonable to think, that if the *Sapo Amygdalinus* of the *London Dispensatory* were made with a Ley of purified Potash and Oyster-shell Lime, instead of common Soap-leys, it would be full as agreeable to the Taste, and possessed of a greater Power of dissolving the Stone.

65. A Piece of *A*, of seventeen Grains and a half, being put in a Solution of *Alicant* Soap in warm Water, had, after six Days warm Digestion, a pretty thick white Crust all round it ready to fall off; which being removed, the undissolved Part weighed fourteen Grains. In nineteen Days it was reduced to six Grains.

There seems to be some Difficulty in accounting for the dissolving Virtue of *Alicant* Soap, upon the Supposition that it is composed of Lime-water, fixed Alcaline Salt and Oil*; for of these three Ingredients only, the first has any considerable Power this way; the second having very little, and the third none at all. The first and second mixed together

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have

* See Note Pag. 3. above.

have not more than the first alone *, and the second and third united have almost none at all; and yet of these two, the Soap chiefly consists. It is however to be observed, that a fixed alkaline Salt mixed with Lime-water, strongly attracts and embraces its subtile active Part, while it precipitates the calcarious Matter of the Water; and that this subtiler Part of the Lime to which the lithontriptick Virtue of its Water is owing, being once united with an alkaline Salt, is neither separated from it by Exposition to the Air, nor probably by boiling over the Fire. Wherefore, since in boiling Soap to a proper Consistence, a great deal of Lime-water is used, the Soap must contain all the active subtile Part of this Lime-water, which being thus concentrated as it were in a very small Quantity of Soap, will greatly increase its dissolving Virtue.

Farther, the small Bits of undissolved Lime which are sometimes found in Soap, make it probable, that the Lime-water used in making it, is often a little turbid, and abounds with many of the grosser Parts of the Lime not fully flaked; whose Virtue being extracted by the alkaline Salt, will still add to the dissolving Power of the Soap.

* Compare No. 10. 11. 12. with No. 63. above.

Is it probable, that the Lubricity given to the Soap, by means of the Oil, may enable the active Parts of the Lime-water and Potash to enter the Pores, and penetrate more easily into the Substance of the *Calculus*, and thus facilitate its Dissolution? With a view to this, I made a Solution of *Alicant* Soap in Stone Lime-water, in order to know whether the Virtue of Lime-water might not be increased by its Mixture with the Soap. Nor was I disappointed: For I found this to have a greater dissolving Power than either a Solution of Soap in common Water, or Lime-water by itself, or even than the Aggregate of the dissolving Powers of Soap and Lime-water when unmixed: For a Piece of *A*, eighteen Grains, after lying five Days in it in a moderate heat, was reduced to six Grains, several white Crusts having fallen off in this time. Finding it had lost none of its Weight, and that no farther sensible Impression was made on its Surface, after standing twenty four Hours longer, and observing that the Bottle was not very closely corked, I suspected that the Solution had lost its Virtue, which evidently appeared by its having lost all Taste of the Lime-water; I therefore put the *Calculus* in a new Solution, where in three Days it

was all dissolved, except a small *Nucleus* weighing a Grain.

[66.] Another time, when I made the same Experiment, I did not find the Virtue of the Lime-water so much increased by the Soap: For a Piece of *B*, ten Grains, put into the like Solution, in two Days and nine Hours, only lost a little more than three Grains; while a Piece of the same Weight, in Stone Lime-water alone, lost in that Time two Grains. Whether the Soap in the one Case was better than in the other, or whether the due Proportion in mixing them was not hit in this last Experiment, I cannot positively affirm.

It may be proper to observe, that the Lime-water must be pretty hot; and the Soap and it must be agitated together for a considerable time, otherwise they will not unite.

The quick Dissolution of the Stone in the two last Experiments, affords a clear Reason for the Success which attended the Stone Lime-water in Mr. *Millar's* Case; which we ought to consider as having had its Efficacy in a good measure heightened by its being taken along with a considerable Quantity of Soap.

67. Having found the dissolving Virtue of Oyster-shell Lime-water much greater than
that

that of Stone-lime, I thought a Solution of Soap in it would have a proportionably greater Effect. But here I was soon disappointed: For I found it impossible by any Art to make them unite; which seems to be owing to the Sea-salt that abounds in the Oister-shells, and which the Fire had not been able entirely to destroy. However, as the Cockle-shell Lime-water (N^o 17.) dissolved Soap, I suspected, that, if Oister-shells were long exposed to the Weather before calcining, the Water procured from them might probably do so likewise. Accordingly, having got some that had lain long upon the Sea-shore, and burnt them, I found the Lime water they afforded mix with Soap as well as any other (*b*): But neither it, nor the Cockle-shell Lime-water, seem to have their Virtue sensibly increased by the Soap.

Are not the Particles of Shell-lime more subtile, saponaceous, and penetrating, than those of Stone-lime? Does not Shell Lime-

K 3

water

(*b*) I boiled some Oister-shells four or five hours, changing the Water thrice in that Time, thinking that this might free them of their Salt, and render their Lime-water miscible with Soap; but without any Effect. However I should advise the boiling and washing of these Shells before they are calcined; as it seems to free the Lime-water of somewhat of a fishy Taste it otherwise has.

water partly owe its greater dissolving Power to this? And, because it is naturally saponaceous and penetrating, is not the Effect of Soap upon it, less remarkable than upon Stone Lime-water, which is more devoid of these Qualities?

[67.] Having poured a very weak Solution of Soap upon some calcined Oister-shells, I procured a Liquor tasting somewhat of Soap, and strongly of Lime; which, in thirty eight Hours warm Digestion, reduced a Piece of *B*, four Grains, to one Grain and one third of a Grain.

After this I dissolved three Drams of Soap in thirty five Ounces of boiling Water, and poured it on five Ounces of calcined Oister-shells. The *Lixivium* which they afforded, tasted strong of the Soap as well as Lime, and was pretty pungent and disagreeable. Being mixed with Urine, it produced the same Appearance as simple Lime-water (*i*); but raised a Smell something like that of burnt Horn. A Piece of *B*, three Grains and a half, being immersed in it, was, in twenty four Hours warm Digestion, reduced to one Grain.

The

(i) See No. 8. above.

The Strength of this *Lixivium* was probably owing to its abounding with the fiery Particles of the Quick-lime; which are more strongly attracted by the Solution of Soap, (on account of the alkaline Salt in it) than by common Water.

68. A Solution of Soap in fresh Small-beer, had no Effect in dissolving some Pieces of *A*, altho' allowed to lie eight Days in it, in a moderate Heat.

69. A Solution of Soap made in one Part of *Scotch Aquavitæ*, and two Parts of Water, has very little Virtue, tho' more than the preceding.

Thus we see, that the dissolving Power of Soap, as well as Lime-water (*k*) is destroyed by fermented Liquors, and greatly weakened by Spirits; and, consequently, how proper it is for such as use it, to abstain from them.

70. I put a Piece of *B*, seven Grains, in a Solution of *Alicant* Soap; which, by being kept in a gentle Heat for four Days, lost two Grains of its Weight.

71. At the same time, I infused two Pieces of *B*, each weighing eight Grains; the one in two Ounces of the above Solution, with a
Dram

(*k*) See No. 24. 25. 6. and 30. above.

Dram of white Sugar ; and the other in two Ounces of the same, with a Dram of Honey : The *Calculus* in the Solution with Sugar, lost about two Grains in four Days warm Digestion, while the other was scarcely diminished in weight above one Grain.

As in refining Sugar a good deal of Lime-water is employed, so it is probable, that some of the more active and subtile Parts of the Lime may adhere to it. And this may be the Reason why it destroys the Virtue of Lime water less than almost any other Substance, and seems scarce to weaken the dissolving Power of Soap at all.

From this Experiment it appears, how much the lithontriptick Virtue of Mrs. Stephens's Medicines must be weakened, by her ordering the Decoction to be sweetened, and the Pills to be made up with Honey ; and that in place of it the *Syrupus de Saccharo* and Sugar may be substituted with considerable Advantage.

72. I infused a Fragment of *B*, five Grains and a half, in a Solution of *Alicant* Soap, made in a strong Decoction of *Asparagus* ; which, after digesting warm for five Days, had lost near two Grains.

73. Most

73. Most People have, doubtless, had Occasion to observe, that while the internal Part of *Alicant* Soap is of a blue Colour marbled with white, its Surface, which is exposed to the Air, is reddish, and sometimes yellow or white. Now, as by the above Experiments we have found, that the lithontriptick Virtues of Soap and Lime-water are in many Instances destroyed by the very same Things; and as Lime-water, by being exposed to the Air, is soon rendered effete, I made the following Experiment, to see, if that Part of the Soap, which has its Colour changed by the Air, possesses less Virtue than the rest.

Having dissolved some of the internal blueish Part of *Alicant* Soap in warm Water. I infused in it a Piece of *B*, six Grains; which, in three Days warm Digestion, lost near two Grains.

At the same time, I made a Solution of equal Strength, of the external Part of the same Soap, in warm Water, and immersed in it, a Fragment of *B*, six Grains: After digesting fifty eight Hours warm, and fifteen cold, it had only lost about three fourths of a Grain.

“ From

α From this Experiment it is plain, that such as swallow Soap for the Stone or Gravel, should carefully throw aside that Part of it which has had its Colour changed by the Air; and as in very old Soap I have seen this about one third of an Inch thick, it is very probable, that two Ounces taken with this Caution will have as much Effect as two and a half, when good and bad are swallowed both together,

β Hence it also appears, how improper it is to make Soap into Pills, unless they are presently to be used; and consequently how much Mrs. *Stephens's* Medicines must have suffered in this way. For, as the Air, in rendering the Soap effete, acts only upon its external Surface, the more the Surface is increased, the greater will the Quantity be that is deprived of its Virtue. Thus, suppose a cubical Piece of Soap of four Inches, made into twelve or fifteen hundred Pills, its Surface, which was before only ninety six, will now, perhaps, be above a thousand square Inches; and consequently, in a given Time, the Pills must lose ten times more of their Virtue, than such a Piece of Soap, if allowed to remain whole. Soap seems also to be rendered a good deal
the

the worse when reduced to a Powder; whereby, not only its lithontriptick Power is weakened, by its Surface being thus increased, and exposed to the Air, but the watery and oily Parts of the Soap being mostly evaporated, leave the alkaline Salt very much exalted, and deprived in a great measure of that which was intended to correct it.

From the above Experiment it still further appears, that the dissolving Virtue of Soap lies chiefly, if not wholly, in the Lime that is in it (*l*); and not in its alkaline Nature, which is not so soon nor so remarkably destroyed by being exposed to the Air.

74. Potash, three Drams, Oil of Olives, five Drams, Stone Lime-water, four Ounces, being mixed, and boiled over the Fire to the Consumption of one half, I put a Piece of *A* in it: but, after standing in a gentle Heat several Days, found no Appearance of its being in a dissolving State.

As in this Mixture the Oil was not sufficiently united with the Potash and Lime-water, I imagine the Surface of the Stone being besmeared by it, hindered these from
having

(*l*) See No. 60. and 66. above.

having that Effect they otherwise would have had (*m*).

From the same Cause I fancy it was that Soap-leys and Oil did not dissolve the *Calculus* in one of Dr. *Hales's* Experiments (*n*). He seems, indeed, to think, that, in order to the Soap-leys exerting their Virtue, the Oil must be separated from them; which he reckons is done in the Course of the Circulation. But, with Submission, I should think it only necessary that the Oil should lose its Nature, so far as to become miscible with Water. Thus we find a Solution of Soap dissolves the Stone, altho' the Oil be not separated from the other Ingredients of the Soap.

75. Dr. *Hales* having been lately informed, that Oister-shell Lime-water, mixed with *Spir. Nitri dulcis*, in the Proportion of an *English* Pint of the former to half an Ounce of the latter, was a more powerful Solvent of the Stone out of the Body than the Lime-water alone; in order to know the Truth in this Matter, he added half an Ounce of dulcified Spirit of Nitre to a Pint of Oister-shell Lime-water, made by pouring a Gallon of
Water

(*m*) See No. 62. above.

(*n*) Vid. Experiments on Mrs. *Stephens's* Medicines, p. 31.

Water on a Pound of calcined Shells, and having filled a Phial of two Ounces with this Mixture, he put into it a Piece of a large *Calculus X*, weighing twelve Grains. At the same time he put into a like Phial, filled with the Lime-water unmixed, another Piece of the same *Calculus Z*, weighing eleven Grains. Both these Phials were placed in a Heap of Dung, whose warmth was ninety four Degrees, according to *Farenheit's* Thermometer.

After forty three Hours, the Surfaces of both these Stones were covered with a white Mucilage, but there was much less of this on the *Calculus X* than on *Z*: the same Difference was observed after sixty three Hours; but after this it became less sensible. In a few Days after the Phials were taken out of the Dung, the Lime-water unmixed lost its dissolving Power entirely; but that to which the dulcified Spirit of Nitre was added, continued for two Months, to turn the Surface of its *Calculus* to a very thin Coat of white Mucilage.

From this Experiment, which the Doctor was so good as to communicate to me, it appears, that dulcified Spirit of Nitre rather weakens than increases the dissolving Power of Oyster-shell Lime-water; but that this

Lime-water mixed with it, retains a lithon-triptick Virtue much longer than it would otherwise do. Whether this dissolving Power, which continues so long, be owing to the Lime-water preserved from becoming effete, by the *Spir. Nitr. dulc.*; or, whether it is not rather to be ascribed wholly to this Spirit, which, when mixed with Common-water, dissolves the *Stone* (o), I shall not presume to determine; though the latter Opinion seems most probable.

However, since dulcified Spirit of Nitre does not much abate the Virtue of Lime-water, and is itself possessed of a lithontriptick Power, it may be safely given to Patients who are under a Course of Lime-water for the *Stone*; and, as it is a good Remedy for Wind in the Stomach and Guts, provokes Urine, allays Heat and Thirst, prevents Putrefaction, and restores a depraved Appetite from corrupted Humours, many Cases may occur, where it may be prescribed, to great Advantage, along with the Lime-water.

We have observed above, (No. 10.) that Lime and its Water volatilize the Salts, and corrupt the Oils of the animal Humours; when

(o) *Rutty's Exper. on Mrs. Stephens's Medicines*, Sect. IV. cap. 35, and 36.

when therefore we meet with calculous Patients, whose Fluids have a more than ordinary Tendency to Putrefaction, it might be very proper to make them add a few Drops of dulcified Spirit of Nitre to every Draught of the Lime-water.

76. A Piece of *B*, twelve Grains, being infused in Spirit of Sea-salt for near seven Days, during the greatest Part of which it was kept in a moderate Heat, had only three Grains of its Substance dissolved.

By comparing this Experiment with those of No. 17. 18. 19. and [64.], it appears, that both Soap-leys and Oister-shell Lime-water are stronger Dissolvents of the *Calculus* than Spirit of Sea-salt.

If an Ounce of Spirit of Sea-salt be mixed with eight or ten Ounces (*p*) of Spring-water, or Lime-water, and poured upon calcined Oister shells fresh from the Fire, a great E-bullition and Heat ensue. After this is over, and the Lime quite fallen to the Bottom, a clear Liquor remains above; which being filtered through a Piece of Flannel, is as pellucid, and void of Colour as Water. This Ley has no Smell; but a pretty strong saline, and somewhat pungent Taste, with a small

L 2

Degree

(*p*) According to the Strength of the Spirit.

Degree of Astringency. If it retains any thing of the peculiar Smell or Taste of the Spirit of Sea-salt, this shews that the Spirit has not been thoroughly saturated by the Lime. To prevent this, I found it of use, to mix with the Spirit of Sea-salt and Water, before I poured them on the Lime, a small Proportion of purified Potash, not with a view to saturate the Spirit, but a little to abate its Force and strong disagreeable Scent.

This Ley of Sea-salt and Shell-lime has very little Virtue in dissolving the *Calculus*. It is true, that, after lying some time in it, in a moderate Heat, the Surface of the Stone becomes white, and throws off a few rotten Scales; but it is three or four times longer in dissolving, than in Oyster Lime-water. And I have observed, that when no Potash was added to the Spirit of Sea-salt, although the Ley were pretty free of the peculiar Taste of the Spirit; yet it seemed to have no Power almost at all of dissolving the Stone.

Hence we see, that while in Soap-leys the dissolving Power of Quick-lime is greatly heightened by the Addition of an alkaline Salt, which of itself has little or no lithontriptick Virtue; this same Quality of the Lime is greatly weakened, or entirely destroyed, by
an

an acid Salt, which is naturally a Solvent of the *Calculus*.

The Quack-Medicine sold at *London*, under the name of the *Liquid Shell*, said to be calcined Shells, reduced to a liquid Form, and discovered by Baron *Schawenberg*, a *German* Nobleman, seems to agree in every Quality with a Ley of Spirit of Sea-salt, Potash and Shell-lime (*q*). They have precisely the same Colour and Taste; mixed with Spirit of Vinegar or Spirit of Vitriol, neither of them effervesce: Hence they are not alkaline. With a Ley of Potash, they make no Ebullition, but are turned into a white *Coagulum*. Upon adding Oil of Vitriol to them, a violent Ebullition ensues, with a strong Smell of Spirit of Sea-salt, and a white *Coagulum* falls to the Bottom. When mixed with a Solution of Mercury in *Aqua fortis*, they immediately precipitate the Mercury.

A

L 3

(*q*) Dr. *Linden*, in an Appendix to his late Book on Mineral Waters, has given us several Processes for making the Liquid Shell; concerning the Virtues of which, he talks more in the Style of an Empirick, than of a rational Physician. His second Method of making it, is by pouring a pound and a half of Water on calcined Oyster-shells and sal *Ammon, crud.* each a Pound.

A Piece of *B*, four Grains, after twenty eight Hours warm, and as long cold Digestion, in a small Phial full of the *Liquid Shell*, had only half a Grain of its Substance dissolved.

Hence it appears, that this Medicine is neither acid nor alkaline, contains little of the Virtue of the calcined Shells, and has but a very inconsiderable Power of dissolving the Stone. How justly then it is said to dissolve the *Calculus* out of the Body in a few Hours, in a moderate Heat, or has been extolled as a grand *Alkali*, and a powerful Solvent of the Stone in the Bladder, is left to every one to judge.

S E C T. XI.

Of the particular Action of Lime-water, in dissolving the Stone.

ALTHO' it is of much greater Importance to Mankind to know that a certain Remedy is able to cure this or the other Disease, than to be informed of the precise Manner in which it produces this Effect; yet to investigate the Operation of Medicines in the Cure of Diseases, is not only a Subject worthy

thy of a Physician, and highly entertaining to a philosophical Mind, but also of very considerable Use in Practice; for it is likely, that a Medicine, whose real Nature and manner of acting upon the human Body are known, will be more judiciously and happily applied in the Cure of Diseases, than one, whose unknown Nature and specifick Operation, scarcely afford any Indication, in what particular Stages of a Disease, or Circumstances of the Patient, it may be used with the greatest Prospect of Success, and the smallest Chance of Mischief; when it may be most proper to administer it, and when to refrain from its Use. As therefore we have made it appear, that Lime-water not only dissolves the *Calculus* out of the Body, but sometimes even while in the Bladder; it will not, I hope, be looked upon as an useless Inquiry to endeavour to point out the particular Manner of its Operation.

The *Calculus* consists of Water, Earth, Air, Salt and Oil. Whatever *Menstruum*, therefore, can separate any of these Principles from the rest, will more or less dissolve or break the Stone.

The Water which enters the Composition of the *Calculus*, is not to be extracted but by
the

the Force of Fire in Calcination, and the Earth is the most fixed and immutable of all its Principles; the Action of Lime-water therefore in dissolving the Stone, must be either upon its Air, Oil, or Salt.

With respect to the first of these, as the *Calculus* when dissolved in a close Vessel, by Lime-water, generates no Air, it manifestly follows, that it does not act by separating this Element from the other constituent Parts of the Stone (q). But as Quick-lime readily unites with Oil, (*Seet. 1. No. 3.* above) it is probable that its subtile and highly attenuated Particles, which are invisibly suspended in the WATER, may seize upon and unite with the oily Parts of the Stone, and so contribute to destroy its solid Form: And the perfectly white Powder to which the *Calculus* is reduced by Lime-water, shews that this *Menstruum* acts, partly at least, by extracting its Oil.

However,

(q) Spirit of Nitre and *Aqua fortis*, indeed, generate a great deal of elastic Air, while they dissolve the *Calculus*, and are probably the most powerful Solvents of this Concretion, because they act so remarkably upon its latent Air, which exceeds in Quantity all its other Principles taken together (a).

(a) *Hales's Staticks*, Vol. 2. p. 191.

However, of all the Principles of the Stone, its Salt is that upon which Lime seems to act most powerfully. Every one knows, that Quick-lime volatilizes crude *Sal Ammoniac*, and Lime-water produces the same Effect, tho' in a less remarkable Degree.

And, as the animal Salts of the Urine and *Calculus* greatly resemble *Sal Ammoniac*. so we find that Lime acts upon them all in the same manner. Thus Urine mixed with Quick-lime, sends forth a penetrating saline urinous Vapour, which is stronger or weaker as the Urine is stale or fresh, or as it is more or less impregnated with Salts. Lime-water has a similar, but much weaker Effect. *Vid. Sect. 1. No. 7. and Sect. 2. No. 10. above.*

A Piece of a *Calculus* which had been in my Custody seven or eight Years, being reduced to a Powder, and mixed with Quick-lime, upon adding warm Water, and stirring the Mixture, sent forth a weak urinous Smell; but if this Stone had been recently extracted from the Bladder, it would have probably afforded a stronger and more penetrating Vapour.

May 12. 1750. I put an Ounce of Gravel-Stones with a Pound and a half of Oister-shell Lime-water, into a well-corked Bottle, and,
having

having observed that the Stones seemed to dissolve no more after the first eight or ten Days, (though kept in a Heat of about 100 Degrees of *Farenheit's* Thermometer) on the 28th I poured off the Lime-water, and found about three Drams of the *Calculi* undissolved; the greatest Part being mouldered down into a white Chalk-like Powder.

The Lime-water had a yellowish Colour, and a very particular kind of urinous, stinking, sulphureous Smell, not easy to be described in Words. It had lost all Taste of the Lime, and, in place of it, had got a very disagreeable one, of the same Nature with its Smell. This putrid Water, after being exposed to the Air three Days in an open Vessel, lost entirely its disagreeable Taste and Smell, but retained its yellowish Colour. Whence we are led to conclude, that as the Colour of this Water proceeded from the grosser Oil of the *Calculus*, which is not volatile, so its Smell was owing partly to the more attenuated Oil, and chiefly to the Salt of the *Calculus* volatilized, and changed into a penetrating Vapour by the Action of the Lime water.

It is observable, that as *Sal Ammon.* mixed with Lime-water, hinders it from throwing up any Scum, so the Lime-water in this Experiment

periment neither afforded an earthy Crust while kept in the Bottle, nor afterwards when exposed to the open Air.

Nor does Lime act thus in volatilizing the Salts of the Urine and *Calculus* alone; for Blood fresh drawn from a Vein, being mixed with equal Parts of Lime-water, immediately acquires a kind of burnt urinous Smell.

From what has been hitherto offered, it may seem to follow, that Lime-water dissolves the Stone, by volatilizing its Salt, and uniting with its Oil: But then, as fixed alkaline Salts join with Oil, and volatilize *Sal Ammon.* and the Salt of Urine as well as Quick lime, it might be expected that a Solution of Potash, or Salt of Tartar in Water, should also dissolve the Stone; nay farther, as a strong *Livium* of any of these Salts acts much more powerfully in volatilizing ammoniacal Salts, and unites much more readily with Oils than Lime-water, it ought by the preceeding Experiments and Reasoning, also to dissolve the Stone more quickly than this *Water*, which however is by no means the Case; for altho' Ley of Potash renders the Stone whiter, more friable and somewhat rotten, yet it does not dissolve it (r).

Since

(r) Vide Hales's Exper. on Mrs. Stephens's Medicines, and No. 62, above.

Since therefore fixed alkaline Salts, which mix easily with Oils, and powerfully volatilize the ammoniacal Salt of the Urine, shew very little Power of dissolving the *Calculus*, the principal and peculiar Action of Lime-water, whereby it so remarkably dissolves this Concretion, must consist in its producing some Change upon the Principles of the Stone, different from what fixed alkaline Salts are observed to do. But the only thing in which the Action of Quick-lime, and of fixed alkaline Salts, upon *Sal Ammon.* and that of Urine, differs, is, that while both seem equally to volatilize these Salts, the former also destroys their Power of effervescing with Acids, and so changes their Nature, as to render them incapable of being reduced to a solid Form. The Virtue of Lime therefore, in dissolving the *Calculus*, seems chiefly to proceed from that Power which it possesses, not merely of rendering the Salts in this Concretion volatile, but of subtilizing and dividing them in such a manner as thoroughly to destroy their Nature and Texture as solid Salts.

Soap-leys, or a *Lixivium* of Potash and Quick-lime is a much more powerful Solvent of the Stone, than either Lime-water or a Solution of Potash in Water, because the alkaline

caline Salt seems, by being joined with the most active Part of the Lime, to unite more readily with the Oil, and act more powerfully upon the Salt of the *Calculus*; at the same Time, that the active Principle of the Lime may, from its Union with the alkaline Salt, acquire a greater Power of volatilizing and destroying the Nature and Texture of the animal Salts: Further, Water impregnated with an alkaline Salt, attracts and retains the subtile Part of the Lime, in much greater Quantity than Water alone.

When a Fragment of a *Calculus* is immersed in Soap-leys, there appear to issue from almost every Point of its Surface *Striæ*, or oily Streams, which run through the Ley, exhibiting much the same Appearance that *Alcohol* does when mixed with Water. These *Striæ* cannot be owing to elastic Air, emerging from the Surface of the Stone, since Soap-leys, in dissolving it, generate no Air. Are they not more probably the oily, and perhaps alkaline, Parts of the *Calculus*, upon which this *Menstruum* acts most powerfully?

It is observable, that while Lime-water dissolves the Stone, it does not affect biliary Concretions, though much less firm and hard. The Reason of which is, that the former a-

bound much more with Salt than the latter; and we have shewn above, that the lithontrip-tick Virtue of Lime-water is chiefly owing to its peculiar Action upon the Salts of the Stone. But a *Lixivium* of Salt of Tartar, although it has little Influence on the *Calculus*, dissolves the biliary Concretions (*s*) ; because the alkaline Salt unites readily with Oil, which is the Principle that abounds most in them. If Lime-water dissolved the *Calculus* by its penetrating Detergency, as some have thought, ought not biliary Concretions to be dissolved by it, since they are more likely to yield to a penetrating detergent *Menstruum*, than urinary Stones ?

Mr. *Morand* has remarked, that Mrs. *Stephens's* Medicines are, not so successful in young as in old Patients (*t*) ; and I have observed the same thing with regard to Lime-water and Soap. At first I was ready to ascribe this to Children's not taking these Medicines regularly, and in the proper Quantity ; but, upon further consideration, I am inclined to think there is something more in it, especially since Dr. *Alston*, who has of late published many curious Experiments on Lime and its Water

(*s*) *Hales's Statics*, Vol. 2. pag. 192.

(*t*) *Memoires de l'acad. des sciences*, 1740, Edit. 8vo p. 256. 268. and 269.

Water, informed me, that he had observed *Calculi* extracted from Children to dissolve more slowly in Lime-water, than those which were taken from old People.

Children, on account of the weak State of their digestive Organs, and their Food being almost wholly of the acescent kind, are remarkably subject to Acidities in the *primæ viæ*. And if we may depend upon Mr. *Homburg's* Experiments, the Blood of young Animals affords a greater Quantity of Acid than the Blood of old ones (*u*); nor can this Acid be wholly deduced from the Sea-salt in their Blood, since in older Animals the Humors abound at least as much with this Salt, as in younger ones. It is not improbable, therefore, that in Children, the ammoniacal Salt of the *Calculus*, may contain a greater Proportion of Acid, than in old People. And as Clays, or argillaceous Earths, are said to be of no Use in Pottery, when deprived of their Acid, because they do not acquire a proper Firmness and Cohesion when burnt; so, perhaps, the Stone in old People may be of a less firm Cohesion, because their Fluids are more destitute of an Acid, than those of Children.

M 2

The

(*u*) Memoires de l'acad. des sciences, 1712.

The Medicines, therefore, against the Stone, are probably less successful in young than in old Patients ; not only because their Efficacy must be more weakened by the greater Proportion of Acid in the *primæ viæ*, Blood and other Humors of the former, but also on account of the greater Firmness and Cohesion of the Principles of the Stone.

S E C T. XII.

Of the Cure of the Stone.

HAVING given an Instance of the Success of Lime-water in dissolving the Stone, and illustrated its Virtue this way by a Variety of Experiments ; in the Course of which we have been so lucky as to discover the remarkable Virtue of Oyster and Cockle Shell Lime above Stone-Lime ; it remains that a Method of Cure be laid down, founded upon the above History and Experiments.

I. First, then, I would advise the Patient to swallow every day, in any Form that is least disagreeable, an Ounce of the internal
Part

Part of *Alicant* Soap (*x*), and drink three *English* Pints or more of Oister or Cockle Shell Lime-water. If he takes the Soap in Pills, or shaved down as Mr. *Miller* did, he may divide it into three Doses; the largest to be taken, fasting in the Morning early; the second, at Noon; and the third, at Seven in the Evening; drinking above each Dose a large Draught of the Lime-water; the Remainder of which he may take any time betwixt Dinner and Supper, instead of other Liquor (*y*). The disagreeable Taste of the Lime-water may be blunted, by adding a very little Sweet-milk to it; and is quite destroyed, by washing one's Mouth immediately after drinking it with a little Vinegar and Water; which, however, must be carefully spit out again (*a*). But, if the Patient

M 3

finds

(*x*) The external Part, which is discoloured by the Air, is deprived, in a good measure, of its Virtue, See No. 73. above.

(*y*) The least proper Time for taking Soap and Lime-water, (as well as most other Medicines) is immediately after a full Meal, because in this way their Virtue will not only be much weakened by being mixed with a large Quantity of Aliments mostly acescent, but they will not be so readily received into the Blood when the Stomach and Guts are previously stuffed with Food, as when they are nearly empty.

(*a*) One Dram and a half, or two Drams of Juniper-berries, infused in every Quart Bottle of it, will mend its Taste somewhat.

finds Difficulty in taking the Soap in this Form, or if it does not sit easy on his Stomach, let him dissolve (b) an Ounce of it in an *English* Pint and a half of warm Lime-water, made with Shells that have been long exposed to the Weather, and take this at three different times, drinking the rest of the Lime-water by itself. If it should happen, that Shell Lime-water cannot be had, then let him take the same Quantity of Stone Lime-water, with at least an Ounce and a half of Soap; since its dissolving Power is so much increased by it (c).

It is observable, that a Solution of Soap in Lime-water has not so disagreeable a Taste, as a Solution or Decoction of it in common Water.

The Soap is not only proper to be taken along with the Shell Lime-water, as it is endowed with a considerable Power of dissolving the Stone, but likewise as it will destroy all
acid

(b) A Solution is preferable to a Decoction. See No. 56. above.

(c) See No. 66. above. —

With regard to the Quantity of Soap, to be taken by calculous Patients, Dr. *Alston* has judiciously remarked, that no more is to be used than keeps the Belly soft; for, when it purges, what goes off this way cannot act on the Stone. *Dissert. on Quicklime. p. 25.*

acid Humors in the Stomach and Guts, contribute greatly to keep the Belly easy, and prevent any Costiveness that might otherwise be occasioned by the Lime water.

At first the Patient should begin with a smaller Quantity of the Lime-water and Soap than what is mentioned above; perhaps an *English* Pint of the former and three Drams of the latter, taken daily, may be enough. This Quantity, however, he may increase by degrees; and ought to persevere in the Use of these Medicines, (especially if he finds any Abatement of his Complaints, or Symptoms of the Stone dissolving) for several Months, nay, if the Stone be very large, for Years.

Further, it may be proper for the Patient (if he is severely pained) not only to begin with the Soap and Lime-water in small Quantities, but also to use the second or third Lime-water, instead of the first. However, after he has been for some time accustomed to these Medicines, he may not only take the first Water, but, if he finds he can easily bear it, heighten its dissolving Power still more, by pouring it a second time on fresh calcined Shells (*b*). An *English* Quart of this
strong

(*b*) Vid. Sect. iii. No. 21. above.

strong Lime-water, with an Ounce, or an Ounce and a half of Soap dissolved in it, and taken daily, would, I dare say, answer as well in calculous Cases, and be as little disagreeable, as any Method yet proposed.

During a Course of Lime-water and Soap for the Stone, the Patient should abstain from all acid and fermented Liquors, as Vinegar, Wine, Ale, Beer, Cyder, &c. For his Drink he may have Milk and Water, or a Ptisan made with Roots of Althea, Parsley, and Liquorice: But, if he has been accustomed to more generous Liquors, and cannot confine himself thus far, he may be allowed a little Mountain Malaga, or some weak Punch, made without any Acid; but, as the Virtue of Soap is much weakened when dissolved in Punch (*c*) and entirely destroyed by Spirits (*d*); and as Quick-lime has its Nature considerably changed by them (*e*), they ought not to be drunk by themselves, nor even in Punch to any great Quantity. It will also be proper to be sparing in the Use of salt Meats (*f*), and Honey (*g*), and to refrain from all Fruits that

have

(*c*) See No. 69. above.

(*d*) Hales's Experiments, p. 2.

(*e*) See No. 1. & 2. above.

(*f*) No. 50.

(*g*) No. 34. & 71.

have any Acidity or Sharpness (*b*) ; while, on the other hand, Milk and Sugar (*i*) and animal Food, with the Vegetables mentioned N^o 39.—45. may be safely used.

It may be worth while here to take notice, that some who have advised Mrs. Stephens's Medicines, and Soap and Lime-water for the Cure of the Stone, have, at the same time, most injudiciously, recommended Dr. Lobb's Diet for calculous Patients. — Dr. Lobb has distributed our vegetable Aliments into three Classes, *viz.* those which have some considerable power of dissolving the softer kind of Gravel-stones, those which have a weaker dissolving Power than the former, and those which have no dissolving Power at all : but it is to be observed, that of the Articles in the first and second Classes, which are alledged to have some lithontriptick Power, more than one half are of an acid or acescent Nature, and consequently must greatly destroy the Virtue of Soap and Lime-water ; a few Days Use of which will communicate more of a dissolving Quality to the Urine, than as many Years Perseverance in Dr. Lobb's Diet.

As

(*b*) No. 36. & 38.

(*i*) No. 33. & 3.

As the Cure depends upon the Urine being strongly impregnated with the Virtues of the Lime-water, the Patient ought to drink no more of any other Liquors than is necessary to quench his Thirst, and should retain his Urine as long as he can without Uneasiness, that it may have the greater Time to act upon the Surface of the Stone.

If, from catching cold, or too violent Motion or Exercise, the Patient's Pains shall happen to be greatly increased, it may be proper to lessen, or even to abstain for a few Days from his Medicines, and to have recourse to Opiates, emollient Clysters, Fomentations and warm Baths. If the Soap and Lime-water shall occasion a greater Heat and Thirst than usual, thirty or forty Drops of dulcified Spir. of Nitre may be taken in a Draught of Lime-water twice or thrice a Day (*k*).

If the Lime-water should chance to occasion Costiveness, it will be proper now and then to take a Pill, of equal Parts of Aloes and Soap, or any other of the Purgatives mentioned No. 51—55.

If, instead of the Soap, a Quarter of Ounce of a Ley made with purified Potash and calcined Oyster-shells, diluted with five Ounces
of

(*k*) Vid. Sect. x. No. 75. above.

of Lime-water, an Ounce of sweet Milk, and half an Ounce of Syrup of Sugar, were swallowed twice or thrice a-day; it would, probably, be less burdensome to the Stomach, and certainly would contribute more to the speedy Dissolution of the Stone, as it is possessed of a much stronger lithontripectick Virtue than the Soap. And this Ley is preferable to common Soap-leys, as we have already observed; not only upon account of its being less nauseous, but also as it is a more powerful Solvent of the *Calculus*. (l).

But if we should meet with any Patients who have an invincible Aversion to Soap in any Shape, or to whom, upon account of Ulcerations in the urinary Passages, it would be improper either to prescribe Soap or this alkaline Ley; in such Cases the above Experiments give us reason to think, that Oister or Cockle Shell Lime-water alone drunk in large Quantities, will have fully greater Effect in dissolving the *Calculus*, than Stone Lime-water, even when assisted by Soap (m): So
that,

(l) See above, No. [64.]

(m) Compare the Experiments of the dissolving Power of Oister and Cockle Shell Lime-water, No. 14—20. with Experiments of the Effects of a Solution of Soap in Stone Lime-water, No 66.

that, in place of all Mrs. *Stephen's* Medicines, which to many delicate People can be of little Use, we may substitute this Lime-water with equal, nay probably greater Success.

To put this beyond any reasonable Doubt, I need only relate the following Experiment.

Dr. *Hartley's* Mass of Soap, Lime, and Salt of Tartar (*n*), which contains every thing valuable in Mrs. *Stephens's* Medicines, is by him ordered to be taken from three to four Ounces a day; and I have often prescribed Lime-water from three to four *English* Pints daily: To know therefore from which of the two Medicines the greatest Benefit is to be expected in the Cure of the Stone, I dissolved that Gentleman's Mass in sixteen times its Weight of boiling Water, and immersed in it a Piece of *B*, of thirteen Grains; and at the same time infused another Fragment of *B*, of the same Weight, in Oister Lime-water, made with six Pounds of Water, to one Pound of fresh calcined Shells. After thirty five Hours warm and twenty three cold Digestion, the Fragment in the Lime-water had six Grains and a half of its Substance rotten and dissolved, while that in the Solution of Dr. *Hartley's* Mass had only lost three Grains.

Dr.

(*n*) See Page 2. and 3. above.

Dr. *Hartley* in his *Latin* Epistle to Dr. *Meud*, published last Summer, has proposed a Variety of Methods, in which Powder of Lime, Soap, Soap-leys, or fixed alkaline Salt, may be taken for the Cure of the Stone: But as the following Composition, which was communicated to me, at his Desire, by Dr. *Hales*, differs in some Things from any of the *Formulas* in his Epistle, I shall here give it to the Publick.

“ Take *Alicant* Soap shaved, eight Parts,
 “ Oyster-shell Lime, one Part; pour upon
 “ them a little Water, and beat them into
 “ a soft uniform Mass: Then dissolve this
 “ Mass into an Emulsion, by adding more
 “ Water, so as to make six Quarts of Emul-
 “ sion from every Pound Averdupois of Soap.
 “ Let this Emulsion stand exposed to the Air
 “ for a Month in a wide mouthed Vessel, be-
 “ ing stirred frequently and laved in and out
 “ of the Vessels, as in cooling Liquors. By
 “ this Means it will become mild to the
 “ Taste, Stomach, and urinary Passages.
 “ The Dose is half a Pint three times a day.
 “ It may be called the alkaline Emulsion for
 “ the Cure of the Stone.”

Altho' it is probable that this Emulsion,
 like the Solution of Dr. *Hartley*'s Mass above

N

mentioned,

mentioned, would dissolve the *Calculus* out of the Body, more slowly than strong Oyster-shell Lime-water ; yet it may perhaps produce as great or greater Effects in the Body, because it contains a certain Quantity of Lime not fully flaked, which must therefore communicate its Virtues to all the Humours it meets with in its Passage thro' the Stomach and Guts. However, as the safest, and least offensive, way of conveying the Virtues of Lime into the Blood, is by drinking its Water ; and as this Water, by being poured a second or third time upon fresh calcined Shells, may have its Strength and dissolving Power increased (o) ; I would still prefer it to Powder of Lime, in whatever Form. But, in Cases where the Lime-water and Soap fail in giving the Patient Relief, the above Emulsion may be safely tried.

Such as have no Stone in the Bladder, but are subject to frequent Fits of Gravel in the Kidneys, might very probably prevent these, by drinking every Morning, two or three Hours before Breakfast, an *English* Pint of Oyster or Cockle Shell Lime-water ; which though it might be too small a Quantity to have a sensible Effect in dissolving the Stone,

yet

(b) Vid. Sect. iii. No. 21. above.

yet would probably prevent any new Concretions.

Patients who have small Stones in their Kidneys, often pass (especially before a nephritick Paroxysm) dark-coloured Urine, very much resembling Moss-water or Coffee, and frequently feel some kind of dull Pain or Uneasiness in that Part of their Back where the Kidneys lie. I have known some Patients, who, after discharging this kind of Urine for several Weeks, have in two or three Days voided 70 or 80 small Stones, like Pin-heads; after which they continued for a considerable time free of all gravelish Complaints.

The dark Colour of the Urine in these Cases, is owing to Blood mixed with it, which ouzes slowly, and in small Quantity, from the Vessels of the Kidneys eroded by the rough Surfaces of the Stones lodged in them. This Blood does not run into Clots, because it is mixed with the Urine very gradually, and only in a small Proportion; and it loses its red Colour, by being retained a considerable time in the Body, before it is evacuated. In like manner, Blood ouzing slowly from the small Vessels of the Stomach, and lying there for some time, is vomited up of a dark Coffee-colour, and often mistaken for black Bile;

whereas, when it flows in a greater Stream, and from larger Vessels, it is thrown up with its natural Colour, either in Clots, or in a fluid Form. The best Remedies for this dark coloured Urine, are mucilaginous Drinks, such as *Arabic* Emulsion, a Decoction of *Althea* Root, or an Infusion of Lintseed, which defend, in some degree, the Vessels of the Kidneys against the Roughness of the small Stones lodged in them; and Lime-water, which, while it softens and renders smooth the Surfaces of these Stones, has, at the same time, a Tendency to heal the eroded Parts. Proper Doses of *Opium* are also useful, as they not only facilitate the Expulsion of the small Stones lodged in the Kidneys, but lessen their Power of doing Mischief while they remain there.

II. In order to render the Cure of the Stone in the Bladder still more speedy, I shall offer a Proposal which, how far it may succeed, is left to the Judgment and Experience of others.

It is this, that such Persons as have a Stone in the Bladder, should, at the same time they are taking the Medicines above directed, have four or five, or more Ounces of tepid Shell Lime-water injected into their Bladder every Day, to be retained as long as they can without Pain;

Pain ; for which Purpose they should evacuate their Urine immediately before the Injection. Were it not for the Trouble of introducing the *Catheter*, such Injection might be made twice or thrice a-day ; and if a flexible *Catheter* were always kept in the Bladder (*p*), it might be done as often as one pleased, and so the Dissolution of the largest Stones might be quickly procured. It may perhaps be proper to let the Patient drink Lime-water some Days before he uses it by way of Injection, in order to mitigate his Pains, and take off that tenderness of the internal Coat of the Bladder, which generally attends this Disease ; after which he will, with less Difficulty, be able to retain it when injected, so as it may have time to act on the Surface of the Stone.

The Injection of warm Water into the Bladder has often been practised in order to the high Operation for the Stone ; and if then it was sometimes attended with bad Consequence, this seems to have been owing to the great Quantity injected, whereby the muscular Fibres of the Bladder, which resist such Distension, were too much and too suddenly stretched : But in the present Case (unless the Stone be very large) so small a

- N 3 -

Quantity

(*p*) Heist. chirurg. p. 883. and 938.

Quantity will be sufficient, that if it be cautiously gone about, I do not see any Hurt it can do. And as from the Quantity to be injected, no bad Consequences are to be feared (*q*), so neither is it probable, that from the Quality of the Liquor any would arise: For Lime-water, we see, may be taken into the Stomach in great Quantities without any Harm, and when applied to the Eye, one of the tenderest Parts of the human Body, it occasions no considerable Uneasiness: It is made use of to wash Sores with very good Success. And, as sometimes along with the Stone there are small Ulcers or Excoriations in the Bladder, the Lime-water, either injected

(*q*) In *Le Dran's Observat.* 80. we find a Decoction of Marshmallows was injected into the Bladder, Morning and Evening, for a considerable Time, without the smallest Inconveniency, and with remarkable good Success in that particular Case; which was, as he calls it, a *Vessie racornie*. To save the Trouble of introducing the *Catheter* twice, he let it remain in the Bladder from the Morning till after the Evening Injection was over. And in *Dr. Hales's Staticks*, Vol. 2. p. 212, we are told, that in four Hours Time he caused, by means of a double *Catheter* there described, 900 cubick Inches, or three *Eng.ish* Gallons of warm Water, to flow in and out of a Bitch's Bladder in a continual Stream, without the least Harm or Inconveniency to the Animal that he could perceive.

jected or taken by the Mouth, will dispose them to heal up, instead of having any of the bad Effects which are to be feared from Mrs. *Stephens's* Medicines, which render the Urine highly alkaline; and of which I had, some Years since, occasion to see an Instance in a Patient, who having several Symptoms of a Stone in the Bladder, had frequently taken a good deal of Soap, by which his Pains, especially in making Urine, were always so greatly increased, that he was obliged to lay aside the Use of it: But, upon inquiring more narrowly into his Case, I found he had, along with the Stone, an Ulcer in his Bladder, and passed considerable Quantities of purulent Matter. Agreeably to this Mr. *Morand* has observed, that in such Cases where, along with the Stone, there were any Ulcerations in the Bladder, Mrs. *Stephens's* Medicines always occasioned great Pain and Uneasiness (*r*); while, on the other hand, Dr. *Langrish* found, that, when, by injecting too great a Quantity of Soap-leys, he had made Dogs void Blood with their Urine, Lime-water would immediately be retained in the Bladder without any Uneasiness, and quickly heal up the small Vessels, which
the

(*r*) Memoires de l' acad. des sciences, an. 1740.

the Acrimony of the Soap-leys had eroded (s).

That the Injection of Lime-water into the Bladder may be rendered more safe, and attended with less Uneasiness, two Scruples or a Dram of *Starch* may be dissolved in six or eight Ounces of Oister Lime-water, and just brought to boil over the Fire, stirring it all the while: For having put a Piece of *B*, seven Grains, in such a Mixture as this, in three Hours Time there was a white rotten Crust formed all round it, which fell off upon shaking the Glass, and, in twenty four Hours time, above a Grain of it was dissolved. The Heat used in this Experiment did not exceed 100 Degrees in *Farenheit's* Thermometer.

The fourth Part of the Yolk of an Egg being mixed with six Ounces of Lime-water, does not weaken its Virtues any more than the *Starch*, and may occasionally be used in place of it.

I tried also *Gum. Arab.* and *Sem. Lini.*; but they both destroy the Virtue of Lime-water, more than the *Starch* or Egg.

I was very much pleased to find, that the Proposal I had made in the first Edition of this *Essay*, of injecting Lime-water, into the Bladder,

der, with a view to the Dissolution of the Stone, had engaged the ingenious Dr. *Langrish* to pursue this matter a good deal further. This Gentleman, in his *Physical Experiments upon Brutes*, published 1746, has shewn, that the Bladders of Dogs can not only bear Stone and Oister-shell Lime-water injected twice a-day for a Month, without any Pain or ill Effect following, but Lime-water mixed with Soap-leys, in the Proportion of fifteen, twenty, or twenty five Drops of the latter, to each Ounce of the former, provided a little Starch be added to blunt the Acrimony of the Soap-leys.

In the Year 1745, Mr. *John Campbell*, late Surgeon in this Place, at my Desire, injected near two Ounces of Oister-shell Lime-water, in which a little Starch was dissolved, into the Bladder of a Boy about ten Years of Age, who had been taken into the *Royal Infirmary* to be cut for the Stone. We directed him to empty his Bladder before the Injection was made, and he retained it without any Pain or Uneasiness for near three Hours.

Mr. *Campbell* after this injected, into the Bladder of a Man, Lime-water unmixed with any thing to soften it; which, however, gave no Pain nor Uneasiness, although retained a considerable

considerable Time. So that from these Trials upon the human Body, and Dr. *Langrish's* Experiments upon Dogs, it appears, that the only thing wanting in order to the Dissolution of the Stone by Injections, is an easy way of conveying these into the Bladder; for the introducing a common *Catheter* twice or thrice a-day, would necessarily give a good deal of Uneasiness, and soon fret the Parts; and it is not easy to contrive a flexible *Catheter* that could be always retained in the Bladder, without considerable Inconveniency. I have for some time entertained an Opinion, that, if a Syringe was made with a small Pipe joined to it, which might be introduced three or four Inches into the *Urethra*, and the *Penis* grasped pretty firmly, so as that it should closely embrace the Pipe of the Syringe, a Liquor might be pushed with such Force into the *Urethra*, as to overcome the Resistance of the *Sphincter Vesicæ*, and make its way into the Bladder, without doing any Harm, or giving much Pain (*t*). And in this Sentiment I have been

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(*t*) Or perhaps it might do better if there was an Ivory Pipe made five or six Inches long, and of the Size of a common *Catheter*, with a Sheeps-bladder tied upon its great End,

confirmed by a Gentleman, who was some Years ago my Patient; for he assured me, that he had frequently, without any *Catheter*, forced the *Sphincter*, and thus injected Lime-water into his Bladder, for the Cure of an Ulcer there. Nor do I apprehend, that an Injection forced into the Bladder, in this way, would be in any danger of penetrating into the excretory Ducts of the *Prostatæ*, or *Vesiculæ seminales*, before it overcame the natural Contraction of the *Sphincter*.

But as some of my Friends, for whose Judgment I had a great Regard, seemed to be of opinion, that the *Sphincter* of the Bladder could not be forced in the way just now mentioned, I did not prosecute the thing any farther: nor did any one else take the *Hint*, from the year 1747, that I first published this Proposal *, to June 1752, when, in order to
be

End, as is usually done in Clyster-pipes: For if the Injection was put into this Bag, and one Pipe introduced into the *Urethra*, it could be much more equably forced into the bladder, than by a Syringe, which is apt to jerk, and is far from being so much at one's Command. See Langrish's *Experiments*, p. 51.

* Vid. Edinburgh Medical Essays, edit. 3. Vol. V. part 2. p. 228.

be fully satisfied in this matter, I desired Mr. *William Butter* Student of Physick, to try whether he could not inject a Liquor, in the Manner above proposed, into the Bladders of some of the Patients of the *Royal Infirmary*; in order to which, I directed him to get an Ivory Pipe made of about 4 Inches in Length, and of such a Diameter that it might easily enter the *Urethra*, and to mount it with a Bladder in the same way as is done to a Clyster-pipe.

In consequence of this, Mr. *Butter* procured an Ivory-pipe of about $4\frac{1}{2}$ Inches in length, whose Diameter was $\frac{1}{8}$, and its Bore $\frac{1}{16}$ of an Inch: Upon the great End of this Pipe, which was formed like a common Clyster Pipe, he tied an Ox's Bladder; and, having put four or five Ounces of warm Milk and Water into it, introduced the Pipe near four Inches into the *Urethra* of *Thomas McCusky* aged nineteen; then directing him to grasp his *Penis* strongly with his Hand, he pushed forward the Injection with a good deal of Force; but, thro' a Neglect of some of the Directions to be mentioned below, little or none of the Liquor penetrated into the Bladder. However, after a few unsuccessful Trials, he pushed first four Ounces of Milk and Water, and afterwards

afterwards four Ounces of Milk, into the Bladder of this Patient, without giving him any Pain or Uneasiness.

But as this Experiment did not succeed quite so well when I was present, I ordered a Pipe to be made of the same Diameter with the one above mentioned, but of 7 Inches in Length, thinking that, by this means, the injected Liquor might be made to act with more Force upon the *Sphincter* of the Bladder. As a Piece of Ivory could not be procured 7 Inches long, the Pipe was made of Tin. Upon the great End of it a Bladder was fastened; into which having put five Ounces of Stone Lime-water, with half that Quantity of Milk, and firmly tied the Bag, Mr. *Butter* introduced the Pipe into the *Urethra* of the before mentioned Patient, ('till, with my Finger, I felt the Point of it within less than an Inch and a half of the *Anus*) and endeavoured to push forward the Injection by strongly pressing the Bag, which, being too weak, burst before almost any thing had got into the Bladder. But, having afterward procured a stronger Bag, he injected, between the Hours of Two and Eight in the Afternoon of this Day, four different times, into the Bladder of *Thomas M'Curfy*, five Ounces of tepid Oyster-shell Lime-water, unmixed with

any thing. The Injection was generally performed in a Minute, sometimes a good deal sooner. The same Afternoon, viz. *June 30. 1752*) he injected five Ounces of Lime-water into the Bladder of *Thomas Sanderson*, another Patient in the *Infirmery*, aged 30, in the Space of forty Seconds. These Patients neither complained of Pain when the Pipe was introduced, the Injection pushed, nor when they voided the Lime-water; only *M^cCursy* said, he perceived a little more *Stimulus* than when he used to make Urine, but not so much as to give him any Uneasiness worth mentioning. They had no Inclination to empty their Bladder immediatley after receiving the Injection, and were able to retain it without any Difficulty. Altho' the Lime-water was perfectly limpid, yet when they voided it, after having been retained some Time in the Bladder, it had a turbid Appearance, and looked as if a few Drops of Milk had been added to it. That this Change of Colour in the Lime-water was owing to the Urine mixed with it, during its Stay in the Bladder, is evident from *Sect. II. N^o 11.* where it is shewn, that Lime-water when mixed with Urine, becomes whitish and turbid.

July

July 6. Mr. *Butter*, when I was present, injected with the short Pipe, near five Ounces of Milk and Water, in little more than half a Minute, into the Bladders of the same two Patients, notwithstanding one of them had, at the Time the Injection was made, a little of a Strangury from a Blister on his Head. Whence it appears, that the Length of the Pipe is not a Circumstance so material as, at first, I was apt to imagine.

In order to make the Injection of Lime-water into the Bladder succeed better, it may be of Use to attend to the following Directions, which were observed by Mr. *Butter* in most of the above Experiments.

1. The Patient ought to empty his Bladder immediately before the Operation.

2. He should lie in Bed upon his Back, with his Legs drawn up to his Body, and his Thighs asunder.

3. He should be forbid to restrain Respiration, but desired to breathe in his usual way. He must likewise be put on his guard, to give no Resistance to the Injection, when he feels it entering into his Bladder, and to restrain any Attempt to make Urine, altho' he should, at that Time, have a small Inclination to it.

4. The Liquor to be injected should be blood-warm, or nearly so.

5. The Bladder fixed to the Pipe must be strong, and very firmly tied, otherwise it will be apt to burst, or to allow the Injection to escape by the Ligature.

6. The Pipe should be dipt in Oil before it is introduced into the *Urethra*.

7. After the Pipe is introduced, the Patient must compress his *Penis* very firmly with his Hand, else the Liquor, instead of making its way into the Bladder, will return by the *Urethra* towards the Point of the Yard.

8. The Bag containing the Liquor to be injected must be pressed by one or both Hands of the Operator, with a very considerable Force, in order to dilate the *Sphincter* or Neck of the Bladder.

9. At first the Lime-water may be softened, by mixing it with a little Milk or Starch, and only four Ounces of it injected; but afterwards the Quantity may be increased to five or six Ounces, and double Lime-water may be used (*u*).

10. As, from the Principles of Hydrostaticks, it is evident, that the Force required to dilate the *Sphincter* of the Bladder must be, *cæteris paribus*,

(*u*) Vid. Sect. iii. No. 21. above.

paribus, proportional to the Surface of the Liquor contained in the Bag, no more should be put into it, than is intended to be thrown into the Bladder. The not attending to this Circumstance, was not only one Reason of the Bag's bursting, but also of the Injection's not passing so easily into the Bladder, in some of the first Experiments, which were made with the Pipe of $4\frac{1}{2}$ Inches in Length.

It may be worth while to observe, that, as one can, at pleasure, some how relax, in a small degree at least, the *Sphincter Vesicæ*, a Patient would probably, after a few Trials, learn to push the Liquor precisely at the Time of the Relaxation, whence he would make the Injection with more Success upon himself, than the ablest Surgeon could do upon another. But as more Force may be sometimes required than he can apply with one Hand, Mr. *Butter* is of opinion, that, if the Liquor to be injected were put into a Pair of small Bellows contrived for the Purpose, and the Pipe screwed to their Nose, the Patient could with little or no Difficulty bring the Sides of these Bellows together, so as to push the Fluid contained in them into the Bladder with great Force.

In the other Sex, whose *Urethra* is streight and much shorter than in Men, the Pipe above

described, may be introduced into the Bladder itself without giving any Pain, and so the Injection be pushed into it with the greatest Ease.

If five Ounces of Oyster-shell Lime-water were thus injected into the Bladder of either Sex, at seven or eight in the Morning, at Noon, and at Six in the Evening, and retained two or three Hours each time, there can be no doubt but that the Stone must as certainly be dissolved in this way, as if it were immersed in a Phial full of Lime-water, though indeed not so soon. And in Women, who may be easily taught to make the Injection themselves, the Stone must, in time, be so certainly dissolved, that, for the future, it will only be necessary for them to have recourse to the Operation of Lithotomy in very rare Cases, where the Stone is of such Hardness, as to resist the Force of the Oyster-shell Lime-water.

Further, as the severe stimulating Pains, which generally accompany the Stone in the Bladder, are not so much owing to its Bulk, as to the Roughness of its Surface, the Oyster-shell Lime-water injected, in the manner above described, twice or thrice a-day, would not fail, in a very short time, to give certain
Relief

Relief from these Pains, by dissolving the sharp Points of the Stone, and converting its Surface into a soft chalky Substance.

However, it is to be observed, that while Lime-water is thus injected into the Bladder with a view to the Dissolution of the Stone, it ought also to be drunk to the Quantity of an *English* Quart at least, and an Ounce of *Alicant* Soap taken along with it, every Day: As this will not only destroy that Quality in the Urine, whereby it generates and increases the Stone, but will communicate some degree of a dissolving Power to it, and consequently hinder it from weakening the Force of the Lime-water injected into the Bladder so much as it would otherwise do.

When the *Sphincter vesicæ* cannot be easily forced in the manner which I have described above, or by means of Mr. *Butter's* Bellows; Lime-water may, without any Difficulty, be conveyed into the Bladder, by means of Mr. *Daran's* newly invented hollow *Bougie*; which has this Advantage over a *Catheter*, that it may not only be introduced into the Bladder with little or no Pain, but may be retained there for a long time, without giving any considerable Uneasiness to the Patient.

S E C T.

S E C T. XIII.

Comparative Value of the several Medicines.

THAT the Method of Cure just now proposed may appear with greater Advantage, I shall state in few Words the comparative Value of the several Medicines that are thought to bid fairest for dissolving the Stone. Of these only Lime-water and Soap can be taken safely into the human Body. Spirit of *Nitre*, Spirit of Sea-salt, Soap-leys, or the fiery *Lixivium* of No. 64. and Quick-lime, being all deadly Poisons, are only capable of being used when diluted in a large Quantity of some watery Vehicle. And even then they do not promise so much as Lime-water: For as the Virtue of Spirit of *Nitre* seems to consist in its extraordinary corrosive Acidity, which must be in a good measure destroyed before it gets into the Blood, and still more so before it arrives at the Bladder; nothing can reasonably be expected from it, or any Medicines of this kind. I know it has been alledged, that although vegetable Acids are entirely changed by the digestive Powers of the human Body; yet this is not the Case with respect to mineral Acids: To which purpose the learned *Boerhaave*

haave is quoted; who, in his Chymistry, observes, that such Acids as are fit to dissolve Gold, Silver, &c. are generally too strong for the concoctive Powers of Animals, and hence become Poisons. But this Authority is as strong as any thing can be against those who use it: For, if the mineral Acids above mentioned are entirely changed by the Powers of the human Body, it is confessed they can have no Effect in dissolving the Stone; and, if they are not destroyed, they become Poisons, and consequently cannot safely be exhibited with a view to the Diffolution of the *Calculus*.

Spirit of Sea-salt is liable to the same Objections as Spirit of *Nitre*; at the same time that it is not near so powerful a Solvent of the Stone (*x*).

With regard to Soap-leys, or the fiery *Lixivium* of N^o 64. it may be observed, that as they owe a great deal of their destructive Quality to an Ingredient that has scarce any Effect in dissolving the Stone (*y*), they do not seem so well calculated for this End as Lime-water; which, at the same time that it is strongly saturated, with that Principle to
which

(*x*) See No. 76. above.

(*y*) See No. 62. above.

which the Soap-leys owe their Virtue, is free of the alkaline Salt, which renders them in a great measure to noxious. But to set the Virtue which these two Medicines have of dissolving the Stone still in a clearer Light, it may not be improper to compare the Effects which Soap-leys had on Dr. *Jurin*, with what we have seen of Lime-water in the Case of Mr. *Miller*.

Dr. *Jurin*'s Stone in his Bladder seems to have been but of two or three Months standing when he began his Medicines; whereas Mr. *Miller*'s was of above fifteen Months. Dr. *Jurin* took Soap-leys in very large Doses for near five Months before he passed any Stones; and, after taking them near seven Months, does not seem to have been perfectly cured (z): Mr. *Miller*, in seven Weeks after he began to drink Lime-water, voided one Stone, as in three Months he did another, and has ever since been perfectly well. Mr. *Miller* had no Pain upon using the Lime-water (a), but in few Days began to perceive

(z) See his Case, p. 14.

(a) Nor is Mr. *Miller* a single Instance of this: For of all the Patients, for whom I have ordered Lime-water in the Stone, I do not remember that one had his Pains increased by it.

ceive a gradual Abatement of all his Complaints; while Dr. *Furin* had his Pains considerably increased by the Soap leys at first; nor does he seem to have had any sensible Ease, till after using them above four Months.

By what has been just now said, I would not be thought to reject the Use of Soap-leys altogether in the Cure of the Stone; on the contrary, I imagine, that small Doses of this Liquor, taken along with Lime-water (*b*), may contribute greatly to the Dissolution of the *Calculus*: Only I would not chuse to give it in such large Quantities as to occasion great Pain or Heat of Urine to the Patient; or in any Case where there are Ulcerations or Sores in the Bladder. And, instead of common Soap-leys, I would recommend the *Lixivium* of N^o [64.] made with purified Potash and Shell-lime, for the Reasons there offered.

Quick-lime, as we have already observed, has been a long time looked upon by the Chymists, as containing in it a powerful Remedy against the *Calculus*. The Powder of calcined Egg-shells, which makes a principal Part of Mrs. *Stephens's* Medicines, is commended by *Barbette* as of incomparable Use in all Suppressions of Urine from the Stone or Gravel

(*b*) See Sect. xi. No. 1. above.

that it crufts the Stomach all over with a Coat of Lime ; and therefore muft be a pernicious Medicine when taken in large Quantities, and ufed long. .

In answer to thefe Objections, which, as they are founded in Ignorance, reflect little Honour on the Authors of them, it is fufficient to obferve, that a large Quantity of Lime-water contains only a very fmall Portion of earthy Matter (*g*), and that it does not depofite one Grain of this Matter as long as it is kept clofe from the external Air. Since therefore the Urine, while in the Bladder, has as little Communication with the external Air, as if it were in a Bottle hermetically fealed, the Lime-water, which makes a Part of it, can let fall no Powder to cover the Surface of the Stone. Add to this, that Lime-water mixed with *Sal Ammoniac.* or Urine, neither throws up a Scum, nor lets fall a calcarious Sediment, even when expofed to the Air (*b*). Indeed as Lime-water changes the calculous Matter in the Urine into a light white Sediment ; if this fhould be fupposed to cover the Surface of the Stone, it would, in fome meafure, defend the Bladder againft its fharp Points.

It

(*g*) See pag. 48. above.

(*b*) See pag. 21. and 130. above.

It may be thought that Lime-water, perhaps, lets fall Part of its calcarious Matter in the Stomach, which is not always shut, but has a Communication with the external Air as often as we swallow: This, however, seems to be prevented by the little Access which the Air has to the Stomach, the short Stay which the Lime-water makes in it, and the Mixture of the different Things it meets with there. Further, as Lime-water becomes effete, as soon as it loses its earthy Matter (*i*), if it were deprived of this in the Stomach, it would become ineffectual in the Cure of the Stone. But Experience, which is the most satisfactory Proof of the Innocence of any Medicine, shews us, that Lime-water may be used daily in large Quantities, and persisted in for Years, without injuring the Health, impairing the Appetite, or weakening the Digestion; nay, it often mends all these. This was the Case with the Right Honourable HORACE WALPOLE, Esq; who, after he had used Lime-water and Soap above three Years, wrote me, that they were so far from hurting him in any respect, that they had given him a better Appetite, and improved his State of Health.

P 2

Altho

(i) See page 76 &c. above.

Altho' there are few urinary Stones so hard as to resist Oister-shell Lime-water out of the Body, yet, as the Virtues of this Medicine, as well as Soap, are greatly weakened, by their being mixed with the whole Mass of Blood, before they arrive at the Bladder, it is no wonder if they make but small Impression on the harder Stones, and only dissolve such as are of the softer kind. However, even in Cases where they are not able to accomplish an entire Dissolution, they generally give surprising Ease to the Patient, and, at least, prevent the farther Growth of the Stone. They produce the last Effect, by destroying the petrifying Quality of the Urine (*k*); and the first, by wearing off the sharp Points and rougher Parts of the Surface of the Stone, which used to prick and irritate the tender Membrane of the Bladder: At the same time, it is not improbable, that the small Part of the Stone, which is dissolved by the Medicines, may, partly, remain on its Surface, in the form of a white chalky Powder, as happens to Gravel Stones immersed in Lime-water out of the Body.

But, as it would betray no small Weakness to believe, that Lime-water and Soap always dissolve the Stone when they relieve the Patient;

(*k*) Vid. Sect. ii. No. 11. above.

ent; so it bespeaks a Mind greatly under the Influence of Prejudice to deny that these Medicines ever dissolve this Concretion; since there have been many Instances of Patients, who, by the Use of them, have passed calculous Fragments at different times, for Months, nay, Years together. However, as it may be alledged by some, that these Fragments were not Part of a larger Stone, and so no Proof of the dissolving Power of the Soap and Lime-water; I shall here mention the Case of a Patient of my own, where the contrary was evident beyond all manner of Doubt. The Reverend Mr. J. L. a Clergyman of this Church, who had been much afflicted with the Stone in his Bladder, not only found himself greatly relieved of his former Complaints, by swallowing daily, for a few Months, an Ounce of *Alicant* Soap, and drinking near three *English* Pints of Oyster-shell Lime-water, but passed a vast number of calculous Fragments of different Sizes; the largest was $\frac{5}{8}$ of an Inch in Length, and near $\frac{1}{4}$ of an Inch in Breadth. Their Surface was partly covered with a white chalky Crust. All of them were thin and appeared evidently to be *Strata*, Layers or Coats thrown off a large Stone; especially the larger Pieces, which were remarkably convex

on one side, and concave on the other. An Instance not unlike this we have recorded by the celebrated Dr. *Mead*, in the following Words : “ Medicus quidam Londinensis, “ mihi amicissimus, hac ipsa medendi via mer- “ catorem graviter laborantem eripuit ; pluri- “ ma enim frustula, nunc crustularum, nunc “ exiguorum nucleorum instar, simul cum u- “ rina foras ejiciebantur (l).”

Upon the whole, we have found in Lime-water, particularly in that which is made with Oister or Cockle Shells, a *Menstruum* for the *Calculus*, so innocent and mild, that it may be taken into the Stomach without any Harm, and injected into the Bladder without the least Danger of corroding it. Such a *Menstruum* as this the learned *Boerhaave* did not despair of being one Day discovered, as he had found the Spirit of Rye-bread possessed of a surprising Power to dissolve certain Stones, though it did not injure any Parts of the human Body (m).

I don't know whether it will be thought worth while just to observe, that Lime-water appears, from the above Experiments, to be possessed of all the Qualities which *Van Hel-*
mont

(l) *Monita et præcepta medica*, p. 178.

(m) *Element. Chem. vol. 1. de Menstruis.*

mont required in a Medicine that should safely dissolve the Stone: As,

1. *Aptum sit in urinam mutari, ut scilicet locum affectum tangat.* That Lime-water alters the Nature of the Urine, and communicates its Virtues to it, appears from *Exper.* under Sect. ii.

2. *Habeat in se potestatem solvendi repagula calculi.* See *Exper.* under Sect ii. and iii.

3. *Possideat istud in proprietate specifica.*

4. *Sit subtile, ut quaquaversus eat, suumque eminus objectum demoliri queat.* See Sect. ix. N^o 57. 59. and 61.

5. *Amicum sit naturæ, ne scilicet cuncta pervertat.* See Sect. iii. N^o 19. and Sect. ix. N^o 61.

S E C T. XIV.

The dissolving Powers of the Menstrua.

IF, in the foregoing Experiments, the Weights of the several Pieces of the same *Calculi*, and the Times they were immersed in the different *Menstruums*, had been all equal, the Strengths of the *Menstruums* would at first sight have appeared; but since the Case is otherwise, and I did not advert to this Inconveniency

conveniency arising from it, till it was too late; in order to remedy it as much as possible, I shall here subjoin a Table of the Proportions which the dissolving Powers of the *Menstruums* for the *Calculus* in the above Experiments bear to one another; but, previous to it, I shall briefly mention the Grounds upon which it is built.

If the Weights, and consequently the Surfaces of two similar Pieces of the same homogeneous *Calculus* be equal, and the Times during which they are immersed in different *Menstruums* be also equal, the Powers of the *Menstruums* will be directly as the Quantities dissolved.

If the Weights and Quantities dissolved be equal, the Powers of the *Menstruums* will be inversely as the Times during which the *Calculi* were immersed.

If the Quantities dissolved, and Times of Immersion of two similar Pieces of the same *Calculus* be equal, the Powers of the *Menstruums* will be inversely as their Surfaces, and consequently as the Squares of their Diameters, or the Squares of the Cube-roots of their Weights.

Therefore, when the Times, Weights, and Quantities dissolved are unequal, the
Powers

Powers of the *Menstruums* will be directly as the Quantities dissolved, and inversely as the Times and Squares of the Cube-roots of the Weights of the *Calculi*. Thus, supposing M, m, to be the Power of the *Menstruums*, Q, q, the Quantities, T, t, the Times, and W, w, the Weights of the *Calculi*; then

$$M : m :: Q \times t \times \frac{2}{w^3} : q \times T \times \frac{2}{W^3}.$$

If the same *Menstruum* be employed in dissolving similar Pieces of different *Calculi*; when the *Calculi* are of the same Hardness, the Times required to accomplish their *total* Dissolution will be directly as their Diameters. When the Diameters are equal, the Times will be directly as the Hardnesses. Wherefore calling H, h, the Hardnesses, T, t, the Times of total Dissolution, and D, d, the Diameters. $T : t :: D \times H : d \times h$: whence

$$H : h :: \frac{T}{D} : \frac{t}{d} \quad i. e. \frac{T}{\sqrt[3]{W}} : \frac{t}{\sqrt[3]{w}}$$

TABLE

T A B L E.

<i>Menstruums.</i>	<i>Dissolving Powers.</i>
Stone-Lime-water, <i>Experiment</i> 11.	100
Strong Stone Lime-water, <i>Exper.</i> 12.	130
Oister-shell Lime-water, <i>Exper.</i> 16.	296
Stone Lime-water in cold Digestion in the Month of May, <i>Exper.</i> 13.	49
Oister-shell Lime-water in said cold Di- gestion, <i>Exper.</i> 18.	124
Lime-water made with Oister-shells, which had been exposed to the Air for 35 Days after Calcination, <i>Exper.</i> 20.	112
A Solution of Soap in common Water, <i>Exper.</i> 70,	75
A Solution of the internal Part of Soap in ditto, <i>Exper.</i> 73.	108
A Solution of the external Part of Soap in ditto, <i>Exper.</i> 73.	40
A Solution of Soap in Stone Lime- water, <i>Exper.</i> 66. first Trial,	195
A Solution of Soap in ditto, <i>Exper.</i> [66]	150
Oister-shell Lime-water and Sugar, <i>Exper.</i> 35.	184
	Oister-

Menstruums.

*Dissolving
Powers.*

Oister-shell Lime-water and Honey, <i>Exper.</i> 34. — — —	79
A Solution of Soap in common Water with Sugar, <i>Exper.</i> 71. —	67
A Solution of Soap in Water with Honey, <i>Exper.</i> 71. —	34
A Ley of Oister-shell Lime and Potash, <i>Exper.</i> [64] p. 106. —	3112
A stronger Ley of the same kind, p. 103.	3890
Glasgow Soap-leys, p. 106. —	1945

POSTSCRIPT.

P O S T S C R I P T.

Edinburgh, Nov. 9. 1742.

AS I conceive the following History, incomplete as it is, may serve considerably to recommend the Use of Lime-water in the Stone, I have sent it to be published, (if you think it deserves a Place in your Collection) as an *Appendix* to a former Paper upon this Subject.

James Litster, of *Macky's Mill*, in the County of *Fife*, aged fifty seven, about nine Years ago, was much hurt by a severe Fall upon a Millstone; and, after that, began to be troubled with Gravel in the Kidneys, and *Ureters*. At this Time he had a great Pain in one of his Kidneys, and Stoppage in his Belly, like an *Iliac Passion*. After a *Clyster*, he had Passage, and was easier, and the Stone or Stones passed into his Bladder: But he did not observe that he voided any with his Urine, till a long Time after; and has ever since had all the Symptoms of a Stone in the Bladder. He has great Pain in making Urine, is not able to use Exercise, and, upon Motion, feels the Stone pricking him in his Bladder.

Bladder. Riding at a Trot gives him remarkable Uneasiness; and, after it, or much Walking, his Urine is generally tinged with Blood.

He has been subject for several Years to have his Symptoms, at certain Periods, exasperated. During the Fit, he is in great Distress; and his Urine, which he has an Inclination to make every two or three Minutes, comes away in Drops, with severe stimulating Pains. The Fits generally last three, sometimes four Weeks, and return after an Interval of fourteen or twenty Days.

He took Mrs. *Stephens's* Medicines for two Months without any Benefit; but found his Pain increased by them, his Stomach put out of order, and Appetite greatly destroyed.

He has also used Soap for some time, to the Quantity of three-fourths of an Ounce a day; but without any sensible Benefit.

I advised him, along with the Soap, to drink Lime-water made with calcined Cockle-shells, beginning with two *English* Pints; and if it agreed with him, to increase the Quantity to three Pints or more every Day.

Upon the 1st of *June* 1742, a few Days before he began to use the Lime-water, he was attacked with a severe Fit of Pain, and

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Difficulty

Difficulty of Urine ; which lasted twenty Days ; in which Time he passed a good deal of tough Slime. But, in eight or ten Days after this was over, he found himself easier than he had been for a Year before, and made his Urine more freely, and with less Pain.

July 2. Having used the Lime water scarce four Weeks, he rode fourteen Miles to a Market. During the Riding, he felt some Pain in his Bladder. Notwithstanding which, next Day, he was quite easy ; whereas, formerly, if he had made any Journey on Horseback, he was sure the Day following to be in the utmost Distress, and to continue so for seven or eight Days.

When he stoops down, or makes any sudden Motion, he still feels the Stone pushing him in the Bladder ; but not near so sharp as usual. His Urine, since he used the Lime-water, deposites a great deal of whitish Sediment ; and he thinks it has given him a better Appetite than he has had for several Years past.

From the 2d of *July*, he drank above three Pints of Lime-water every Day ; and was very easy till the 20th of that Month ; when he had a Fit as usual ; but it lasted only eleven Days : And then, he had only Pain in making

king his Urine; which, however, was less severe than what he had formerly been used to have. His Belly being generally costive during the Fit, I ordered him an Infusion of *Senna*; from which he had considerable Relief.

He continued very well all the Month of *August*; and walked, upon the 20th of that Month, six Miles in a few Hours, without any Pain or Trouble: Whereas, for some Years past, he could not walk even one Mile without much Pain.

Upon the 1st of *September*, he found his Urine much obstructed, and had a Fit which lasted nine Days: But, though his Provocations to Urine were frequent, and the Difficulty in making it considerable; yet, after voiding a few Drops, he was easy, and had no stimulating Pains. From this Time, to the End of *October* 1742, he was as well as if he had had no Stone, was able to go about his Business, from which he had been long laid aside, and was fit for any Work that did not require great Strength. He can ride now as well, either at a Trot or Gallop, as ever, and never finds any thing pricking him in his Bladder, not even when he has the Fit. From the Beginning of *July* he made no use of Soap, and found no other Inconveniency, than that

he thought the Lime-water bound his Belly a little more for the want of it. He is so sensible of the Benefit he has had by drinking Lime-water, that he is resolved to persist in it, in hopes of a compleat Cure (*b*).

I have had occasion to order Oyster-shell Lime-water for many other Patients afflicted with the Stone; but have not yet met with an Instance, except one, where it was drank to
the

(*b*) From *October* 1742, *James Litster* continued drinking the Lime-water near two Years, to the Quantity of three *English* Pints a-day; during which Time, he passed great plenty of sandy Stuff, was remarkably easy, and went about his ordinary Business without any Pain or Interruption. After *September* 1744, he gave over the constant Use of it: But, when after catching Cold, or great Fatigue, he had Difficulty of making his Urine, with some Pain, and passed a good deal of Slime, with some Sand; upon having recourse to the Lime-water in smaller Quantities, he was soon relieved. Since the Year 1744, he has, upon Motion, felt nothing weighty like a Stone in his Bladder (as he used formerly to do) although he has often walked ten Miles a-day, made pretty long Journeys on Horseback, and frequently rode at a Gallop. So that it seems probable, that the Stone, if yet undissolved, is at least considerably diminished in its Bulk, and softened in its Surface. It may be worth while to observe, that this Patient, notwithstanding his drinking Cockle-shell Lime-water for above two Years, to the Quantity of three *English* Pints a-day, had neither his Appetite nor Digestion any way impaired, nor his Health injured by it.

the Quantity of three *English* Pints a-day, and any tolerable *Regimen* observed, without the Patient's finding himself, in a few Weeks, sensibly easier. * When the Stone is small, this will happen most remarkably, as was the Case with Mr. *Miller* ; but, if it is very large, even after its Surface is softened, and the rough Points worn off it by the Lime-water, it is not to be imagined, but that by its Bulk it must sometimes give Uneasiness, especially in making Urine : But the Patient has this to comfort him, that while he continues his Medicine, the Stone is daily growing less. And there is one sure Mark by which any one taking Lime-water, Soap, or Soap-leys, for dissolving the Stone, may know if his Urine is so far changed, as not to be further capable, at least of furnishing any new Matter for increasing its Bulk, *viz.* if, by the Use of these Medicines, the Sediment of his Urine, from a brownish Colour, becomes white.

Q 3

* If there is, along with a Stone, any Ulceration in the Bladder, as sometimes happens, the Lime-water will often fail in giving Relief ; and yet, it seems even in this Case, to be the best Remedy we know of, especially if it is not only drunk in large Quantities, but also injected daily into the Bladder.

I shall only make one Observation upon this History, which the most rigid Infidels, with regard to the Dissolution of the Stone, must acquiesce in; and that is, Supposing Lime-water could not dissolve the Stone, yet, since it is capable of giving such Ease and Quiet to those who labour under it, whether would it not be more advisable for such, especially if advanced in Years, to resolve upon drinking a Bottle of this every Day, during their whole Life, than submit to one of the most cruel, and, at the same time, not the least dangerous Operations in Surgery?

A P P E N -

A P P E N D I X,

C O N T A I N I N G

The C A S E S of

The Right Honourable

HORACE WALPOLE Esq;

A N D T H E

Reverend Doctor NEWCOME,

Canon of WINDSOR,

[Written by themselves.]

T O G E T H E R W I T H

The Case of Mr. YOUNG GREEN,

[Communicated by Mr. *Alexander Campbell*, Surgeon at *Pool* in *Dorsetshire*.]

I. *The CASE of the Right Honour-*
able HORACE WALPOLE
Esq;

ABOUT eighteen Years ago, when his
MAJESTY resided at *Hampton-Court*,
I was taken ill with what was thought
to be a Fit of the Cholick only, being subject
to that Disorder when I was very young, and
the Physicians treated me accordingly: When
some Days after, I was got perfectly well, in
making Water one Morning, I voided a Stone
in the Pot about the Bigness of a Barley-corn,
which, without doubt, had occasioned, while
it lay in the Ureter, the cholical Pain I had
felt. From that Time, I was frequently trou-
bled with severe Fits of the same Pain, which
lasted until, by Turpentine-clysters, and o-
ther lubricating Medicines, I had brought a-
way a Stone: Being advised at last to drink
a Pint of Whey, made with Cream of Tar-
tar every Morning; and having followed that
Method from the Beginning of *May* to *No-*
vember, at the End of two Years, (during
which

which Time, my Pains frequently returned and ended in the same Manner), I found myself perfectly cured: For, having persisted in drinking Whey yearly, I continued free from those Pains, voiding only at Times some red Gravel till 1747. In the Spring of that Year, whilst I was at a Friend's House in Town, to dine there, having Need to make Urine, I made instead of it what appeared to be almost clear Blood; and so, from time to time, for almost all that Year, I was often called upon to make water, by very short Intervals, which was more or less discoloured, seldom very clear, and frequently attended with great Pain and some Gravel. That whole Year, until the next Spring, I took Variety of Things of a lubricating and cooling Nature, which it is unnecessary to detail, without any good Effect. The next Winter, in Town, I found I grew daily worse, and, altho' I did not always make bloody or Coffee-water, yet my Provocations to Urine, (which, after a hasty Gush of a Spoonful of Water, suddenly stopt with excessive Pain) were more frequent, and were attended with a *Tenesmus* and Irritation at the End of my Yard. Mr. Ranby the Surgeon, and Mr. Graham the Apothecary, having often visited
me,

me, and having got constant Accounts of my Disorder and the Symptoms that accompanied it, both declared, there must be a Stone in my Bladder. I was willing to be probed ; but, as I had no Thoughts of being cut, Mr. *Ranby* declined undertaking that troublesome Office, being persuaded, without the Trial, I had a Stone in my Bladder. Lord BARRINGTON, hearing of my Complaint, was so good as to send me the Volume of *Scotch Medical Essays* containing Dr. *Whytt's* Account of the good Effects which taking Soap and Lime-water had had in Cases similar to mine, with ingenious Reflexions and Directions relating to that cruel Disease, and the Remedy for it. I read them with great Satisfaction, and would have immediately fallen into that Method ; but my Relations, touched with the fatal Effect which Dr. *Jurin's Lixivium* had had upon the late Lord ORFORD, would not suffer me to follow my own Inclinations.

WHILE I had a severe Fit upon me, I was visited by the Earl of MORTON, who, upon hearing what was my Disorder, gave me an Account of the powerful Benefits and entire Cure

Cure which Mr. *Somers* (a) had found, in voiding the Stone that had tormented him for many Years, by adding Lime-water to the Soap, which he had taken for some time without Success.

This Example, by the Encouragement of Mr. *Graham* my Apothecary, fixed my Resolution to follow that Method; and accordingly, before I left the Town, I often perused Dr. *Whytt*'s Essay relating to the Stone.

In

(a) Late one of the Commissioners of his Majesty's Customs in *Scotland*.

The Earl of MORTON having, at this Time, wrote to Mr. *Somers* to know more particularly the Method of Cure which he used, received from him the following Letter, which his Lordship was pleased to give me, with Allowance to publish it with Mr. WALPOLE's Case.

My LORD,

" In obedience to your Lordship's Commands, which
 " reached me yesterday, I have the Honour to send you
 " an Account of the Regimen which recovered me from
 " a most deplorable Illness that had, a long time, baffled
 " our ablest Physicians.

" I

In *March* 1747, I began at first with taking every Day Half an Ounce of *Alicant* Soap, made into Pills, with a Syrup of Marshmallows, and drank upon it about a Pint of Lime-water made of Oister-shells, mixing a Spoonful of Milk with it, and drinking a Spoonful after it, to take away the Nauseousness of the Taste.

Upon the Road, as I went into the Country, in *May* 1748, I had a most severe Fit at *Newport*, making bloody Water, with frequent Interruptions, and short Intervals, attended

R

tended

" I took four Drams of *Alicant* Soap, four times a
 " Day, early in the Morning, at eleven before Noon, at
 " five Afternoon, and at going to bed. Upon a Distaste
 " I have to Pills, I dissolved each Dose in about Half a
 " Pint of Oister-shell Lime water: To make the Draught
 " more palatable, I added a little Milk. The Lime-water,
 " thus mixed, was the only Liquid I drank during
 " my Indisposition; and, as I think its Power alone
 " sufficient to prevent any new Concretion, I intended to
 " continue in that Practice. By this Method, my distem-
 " permal Complaints, in a few Weeks, vanished; and, in
 " about two Months, I happily voided a small Stone, quite
 " smooth, and to be sure much diminished by this Dissol-
 " vent; having frequently before discharged Gravel of
 " the same Colour. I heartily wish it may have the same
 " Effect upon your Lordship's Friend.—I am, &c.

EDINBURGH, *November* 10. .

1747.

tended with violent Pains, which continued upon me to such a degree, that I could not endure the Horses to go more than a foot Pace for above seventy Miles, till I got home.

After my Arrival there, I was tolerably well for some Days, but the least Motion in a Coach, or even in Walking, brought the Disorder upon me. I was always (which is remarkable) entirely easy when I lay a-bed; but was obliged, when I got up, to take to my Couch, and could not venture to move from thence but on some necessary Occasion. In the mean time, I continued to take the Soap and Lime-water, which, by degrees, I increased so far as to take, at different times, an Ounce of Soap, and three Pints of Lime-water a-day; observing a very regular Diet. After some Months I found myself extremely easy in my ordinary Motions; but I never ventured to walk far, nor go at all in a Wheel-carriage, keeping myself as quiet as I could, until I should be obliged to go to Parliament.

Just before I left the Country, Mr. *Ranby* made me a Visit; and, altho' I had felt no Pain or Symptom of my Disease for some time, he advised me not to hazard going to Town, by any means, unless in a Litter; however, having caused a Voiture to be made, I undertook

took the Journey in it, the 20th *December*. 1748, which was regulated by the Horses going no faster than a gentle Walk, and but twenty Miles a-day.

The cold Weather, and the Tediousness of creeping so slow, made the Coachman sometimes fall into a Trot; which I perceived, but finding no Inconvenience, did not check his Pace. The set Stages were observed; but the last two Days, and particularly the last Day, the Coachman drove from *Harlow* to *White-chappel*, as full a Trot as the Horses could go at any Time, and I felt not the least Disorder. I took a Chair at *White-chappel*, and all that Winter used nothing else, and continued extremely well: But, about two Months after my Arrival in Town, I found some small Uneasiness in making water, and in two or three Days, I voided, with my Urine, something of a flat Shape, about the Bigness of a silver Penny, covered with a soft white Mucus, which, when it was dry, was plainly of a stony Substance, and, after that have never since been troubled with the least Symptom of that cruel Disease. And I found myself so well in the Country, last Year 1749, that, contrary to the Advice of all my Friends, I undertook, in my Coach, a Journey to *Chatf-*

worth in *Derbyshire*, at least 160 Miles from my own House in the Country, to pay a Visit to the Duke of DEVONSHIRE, the Horses going as round a Trot as they could conveniently according to the Road; and the last 10, or rather 15 Miles, from *Hardwick* to *Chatsworth*, a most rugged and rocky Way, we neither spared ourselves nor our Horses; and altho' the great Shocks upon the Stones broke the Springs of my Coach, yet they gave me not the least Uneasiness; and I have ever since continued, with respect to my former Disorder, as well as I ever was in my Life: But I now and then voided some red Gravel after I had sat a great while in the House of Commons.

As I never perceived that I voided, during my Illness, any Fleaks of a Stone, besides the above-mentioned, and was never searched by any Instrument; I can no otherwise pronounce it to be a Stone, unless by the Symptoms I felt, and the Judgment of the Surgeon and Apothecary that attended me, from these Symptoms.

But it is very remarkable, as I have said before, that I never felt these Symptoms while I lay a-bed, nor to so great a degree when on my Couch as upon my Legs; which looks as if

if the Posture made great Alteration; and that, methinks, could not have been the Case, if I had been troubled with a scorbutic corrosive Humour only. I must leave it to the learned in Physick, to make what Conclusions they think fit from this true State of my Case. I think I remember in some of Dr. *Whytt*'s Observations, that altho' the Soap and Lime-water were not able to dissolve or bring away the Stone, yet they might cure its painful Symptoms, and hinder it from vulnerating any Part of the Bladder, by blunting its sharp Points, rendering its Surface smoother, and even covering it, in some measure, with a kind of Mucilage, This may possibly be my Case if I have still a Stone there; and therefore I continue to take the third Part of the Soap and Lime-water daily, which I used when I took the full Quantity.

H. WALPOLE.

April 21. 1750.

The SEQUEL of Mr. WAL- POLE's Case.

Containing an Account of the State of his Health, with respect to the Stone in his Bladder, from November 1750, to the End of April 1752.

Cockpit, April 28th 1752.

AFTER having found myself, for two Years together, perfectly well, and free from all Symptoms of my former Disorder, I took no more than one third of the Soap, and Lime-water that I had formerly used.

In November 1750, I came out of the Country in my Coach, in the usual travelling Pace, without the least inconvenience; but having ventured, after I came to Town, to go now and then in a Coach upon the Stones, I began, at times, to feel the Symptoms of my former Disorder, which, upon any Motion, besides that of going in a Chair, even by walking to any degree, increased upon me; and driving only in my Chariot, through the Parks, to *Kensington*, without going upon the
Stones,

Stones, I found myself much troubled with making, frequently and involuntarily, water, sometimes bloody, tho' not with much Pain.

However, taking the Precaution of going by Water, as far as the *Old Swan*, and being carried from thence in a Chair as far as *Whitechappel*, I ventured in a Chariot, fitted up with the best *French Springs*, to go into the Country with Mrs. WALPOLE, last *June* about Mid summer; but before I had got half-way to *Epping*, though the Horses went but a slow Pace, I felt as great Uneasiness, attended with the same severe Symptoms, as I had ever done; which frequently returned and continued upon me, during the whole Journey, for four Days together, with little or no Abatement, but while I was in Bed; where, as formerly, after I had laid sometime, I was perfectly easy the whole Night.

As soon as I got out of my Chariot, upon my Arrival at my House in the Country, I had indeed a cruel Fit; but after I had rested one Night, and kept myself as quiet as possible, for a few Days; I found myself perfectly well again: and as I never went in a Coach, and did not walk much during my whole Stay in the Country last Year, for about five
Months

Months together, I never felt the least Symptom of Uneasiness.

Some few Days before I left the Country, I took a Turn or two round my Park, in my Chariot, free from Pain, which encouraged me to undertake a Journey to Town again, last *November*, in my Chariot, by short Stages and gentle driving ; and it was performed, in five Days, to *White-chappel (a)*, without being sensible of the least Inconvenience any Part of the Way : Neither have I felt any since my Arrival in Town, and I still continue well, taking daily, as I have constantly done since *June 1751* when I went last into the Country, the full Quantity of Soap and Lime-water, that I formerly took ; *viz.* an Ounce of the former, and near three Pints of the latter.

H. WALPOLE.

(a) From Mr. *Walpole's* House in *Norfolk* to *London*, is about a hundred Miles.

Mr. WALPOLE continued well from *April* 1752 to *September* 1754, taking about an Ounce of Soap, and three Pints of Lime-water daily; but finding, of late, that the Soap opened his Belly too much, he has since taken it in less Quantity. In Summer 1754, he frequently rode in his Coach forty *English* Miles a-day without the least Uneasiness, or ill Consequence: and he says he is now quite well, and rather in better Health than formerly, believing that Lime-water, is a great Cleanser and Sweetner of the Blood.

II. CASE of Dr. NEWCOME Canon of WINDSOR.

THE Reverend Dr. *Newcome*, Canon of *Windsor*, had for a Twelvemonth voided large, round, red Gravel, without any Pain, or discoloured Water. In *April*, 1751, after riding, his Water first appear'd bloody, which was attended with a frequent Irritation to make it, tho' with very little Pain. After one Day's Rest, the Water would return to its natural Colour, and he was able to walk about, or use Exercise without any Inconvenience, for nine or ten Days; in which Time his Symptoms usually returned; but soon went off again upon his sitting still. These Intermissions of his Disorder grew gradually less, and a less Motion would occasion Uneasiness, and bloody Water; so that in the *November* following he had hardly any Intermissions at all, and could scarce stir from his Chair without being obliged to pass his Water immediately; and with any little Motion, was sure to void Blood. When his uneasy Sensations had been quieted by sitting still, they would constantly return, if he only walked across
his

his Room. In this State, he began to drink Lime-water, and the following Account of its Success is in his own Words.

I began to take the Lime-water *Nov.* 1751, and in few Days brought myself to drink two Quarts a-day, taking no other Liquid whatever, except Tea; and this I have continued with very little Interruption for above two Years. I found no immediate Effect from it, but continued all the Winter making bloody slimy Water, with irritating Pain upon every little Motion, and a constant Inclination to go to Stool; but, by keeping quiet, I continued pretty easy. The greatest Exercise I took, was walking to Church (not half a Quarter of a Mile distant) and officiating every *Sunday*; and by this I never failed having my Urine discoloured, and the irritating Pains more or less: Yet I began about *February* to think myself better, at least I was satisfied that I was not grown worse; and being obliged, by bad Weather, to go to Church in a Chariot, tho' I felt Uneasiness, I thought I bore it better than I had formerly done; I began too to be less disordered by officiating at Church, but still always in some degree, till *Easter-Sunday*, when, being obliged to stand much longer, and move more, I expected the usual Consequences

sequences of Blood and Pain; but neither happened, nor have ever since, as they used to do by the same Exercise.

I was certain now I could bear Exercise better than I had done; and, encouraged by this, I ventured to ride on Horseback, which I bore once very well; but, on a second Trial, had the usual Consequences of Blood and Pain; and about a Fortnight after, in the Month of *May*, thinking myself abler, I tried the motion of a Chariot; but, tho' driven very slow, I could not bear it half a Mile, and was forced to get out and walk home with difficulty, making much Blood with great Irritation. From this time to the latter end of *June*, I kept quiet and was easy, and, I concluded, better than before I began the Lime-water; but setting out on a Journey to *London* in a Coach, I suffered much in the Journey, and had all my former Complaints in a greater degree than ever. A Week or ten Days Rest, after my Journey, recovered me to my former Ease; but I could bear but little Motion.

I now began to take Soap with the Lime-water: in the middle of *July*, I was obliged to go to *Windſor*; which Journey brought on my usual Complaints, and I continued the three Weeks I was there very indifferent, having

having continual Uneasiness, Gripeings, Dregs of Blood, Irritations, and a constant Feel of going to Stool, and passing, at the same time, a little black sand; but nevertheless I bore the Motion of the Coach in my Journey back, so much better than I ever had done before, since I had been ill, that I could not but conclude I was much better.

August 1752 I was searched, and a Stone found in my Bladder. I continued in Town till the Beginning of *October*, growing better, as I judged, by my being able to move more without bringing on Pain and Blood; and I was confirmed in my Opinion, by bearing a Journey of 160 Miles to my own home with but little Blood or Pain, in comparison with what I had, when I came up three Months before.

All this Winter I kept quiet and enjoyed perfect Health: And by *February 1753*, the Irritations and frequent Motions to make Water and go to Stool had left me, and my Urine was without Slime, and a sort of Oiliness it used to have, and from a dirty Colour, was become Yellow; but at times there would be upon it a strong Scum or Froth which reflected Colours like Mother-of-pearl, and would remain on Paper if not touched (but it could

not resist the least touch) a Day or two, till it dried to a fine Powder. I have not observed any of this Scum these last six Months, nor, as far as I can judge, since I left off Soap.

I had all this while carefully observed my Urine, but could not discover any Fragments of Stone, nor had ever the least Feel in the Passages, as if any thing had made its way. But, about *March* 1753, in a Pot that had been emptied, and by Accident not washed, I discovered hanging, about the Sides, white Particles like Mortar, which seemed to be of a stony Substance, and some few of them I could plainly perceive to be convex ; but I observed very few of this Sort, and indeed not many of any kind at a time, altho' very constant ; and it is probable that I might have passed them long before I attended to it.

The State of Ease I found myself in at this time (*February* 1753) I had come into gradually, and I thought it might in great measure be owing to my keeping quiet, which I determined to continue ; but undesignedly got the Habit of stirring more about ; and found I had little or none of my former Complaints, which had left me so gradually, that I cannot say when it was I was totally free from them. In *March* the bad Weather again obliged me

to use a Chariot to Church, and I felt not the least Uneasiness from the Motion. I now began to walk about without Restraint two or three Miles at a time, and went airing in the Chariot upon paved Roads, without any Inconvenience, tho' driven full Trot.

In *July* 1753 I undertook a Journey to *London*, and bore the Coach as well as I ever did, and in Town went several long and rough Stages, in a Hackney-coach, on the Stones, and from thence to *Windsor* and back again, and then down again to *Whitchurch*; and all this without the least Uneasiness whatever. But, about this time, I began to pass some red Gravel without Pain, which I had not done before for two Years, and at my return home in *September*, had a great Pain in my Loins, which moved at last into the Groin, and for a Fortnight or three weeks some Gravel passed every Day, but without discolouring the Water, or any Irritations, or any of the former Sensations. I have from this time been subject to pass Gravel at times, but with no Pain at all; and a Week before I set out on my last Journey to *London* *March* 1. 1754, some passed every Day, which continued on the Road, and does still much in the same manner it had done for a Year before I

complained of the Stone ; but I feel no Pain, and can bear all sorts of Motion as well as ever I could in my Life.

From *November 1751* to *January 1754*, I punctually took the full Quantity of 2 Quarts a-day of Lime-water, making it my only Liquor, except Tea, and about half the time an Ounce of Soap a-day, and never found myself better with regard to Appetite, Sleep, and indeed in all respects. And the Lime-water which I took at first with some Reluctance, not only came by use to be tolerable to me, but as agreeable as any other Liquor.

September 1753, I began to pour, Morning and Evening, some of my Urine on a Piece of human *Calculus* ; in about two Months its Surface began to turn white, and to appear softened ; and, upon touch, retained the Impression of the Skin of the Finger ; but this, only just on the Out-side, without any Depth ; and the Stone remained hard and firm as before. By degrees the Surface grew more soft, and seemed loose and hollow from the Body of the Stone, as a Shell to it, and, in a few Days, began to crack (in *November*) and scale off : I then took it in my Hand, and found it very rotten, so as not to be touched without breaking Bits from this outward Shell, under which

which the Stone was still hard, tho' Honeycomb'd ; altho' the Surface was so rotten, as not to endure the slightest Touch, without crumbling into coarse Mortar ; yet, if let alone, little came off in Bits ; but it wasted imperceptibly. As the outward Surface came off, there appeared a small Crack round the Stone, as if marked out with the Point of a Knife ; this daily grew wider and deeper, and, upon examining the Stone in my Hand, it came in two, in that place ; and the Surfaces, by which the two Bits had adhered to each other, were quite smooth, and not incorporated into each other, so as to form one Mass, but as if they had been originally two distinct Bodies stuck together by a Cement.

In *December* another Layer came off in the same manner, upon only turning it out of the Bottle ; but I believe neither of these would have come off by themselves ; for these seemed to be other *Strata* separating in the same manner, which being let alone, never came off in Bits, but went off in a sort of mucous Slime. As the Stone was now in three Pieces, and those grown thin, it began to waste very fast, and I was willing to save them ; and therefore discontinued the Experiment in the beginning of *January* just

four Months after I began it. [In which time this Bit of *Calculus*, which weighed at first thirty one Grains, was reduced to six Grains, and these so rotten as hardly to hold together.]

It is to be observed, that I took no Soap during the time of this Experiment. The Urine was gradually made into the Phial, so as not to fall with any Force on the Stone, and care was taken all the while, that no Shock should be given to the Stone, by shaking the Phial, or by any other means. The Urine was changed generally three times in the 24 Hours, but always twice.

III. CASE of Mr. YOUNG GREEN.

[Communicated by Mr. ALEXANDER CAMPBELL,
Surgeon at POOL.]

MR. Green was, from his twelfth Year, subject to frequent sudden Obstructions in making water. In his 15th, on riding a hard-trotting Horse, he felt violent Pains both before and after the Discharge of his Urine, attended with a *Tenesmus*. The Symptoms increasing by degrees, the least extraordinary Motion brought on a Paroxysm, during which he sometimes voided bloody Urine: A Sensation of great Weight and Pressure about the *Anus* was now his constant Complaint, except when in Bed. Sometimes his Urine flowing in a full Stream, suddenly stop'd, and came away by Drops, and he felt the Stone rolling gradually back in his Bladder as its Contraction and the Endeavour to Urine diminished. Tho' I apprehend these Symptoms to be the almost infallible Diagnostics of the Stone in the Bladder, yet Dr. Mead, who was consulted at this time, gave it as his Opinion, that the Disorder was an Inflammation in the Neck of that Bowel.

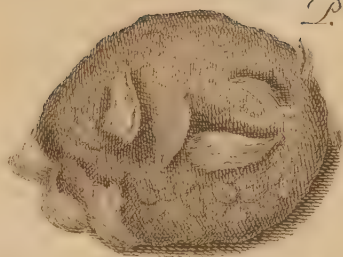
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Although *Mr. Green* wish'd the Doctor's Opinion to be well founded, yet his strict Adherence to the Soap and Lime-water was a manifest Proof that he believed the contrary. He continued the Use of both, from *April 1751* to the Month of *September* following, with little or no Interruption; during which Time, the great Weight and Pressure about the Beginning of the *Urethra* gradually abated. He frequently now made water without Pain; and when he had any Returns of it, it was neither severe nor lasting, but of a sharp smarting Nature: In short, he owned more than once, that he would gladly continue the Use of the Medicines during the Remainder of Life, could he be assured of enjoying the same degree of Ease he then felt, without a Prospect of better Health.

His Urine during this time demitted a copious Sediment; sometimes, especially after a Fit, a thick mucilaginous Substance, which being dry'd, yielded 57 Grains of a greyish Powder, interspersed with shining Particles, not unlike the inner *Stratum* of Oyster-shells. In *September* his Business led him to *London*, where he was induced to be cut by *Mr. Sharp*. Ten Days after the Operation he died.

The

P. 213.



The Figure of the Stone

The Stone is of a dark brown Colour (but I was informed its Surface was much lighter and in some parts white when first extracted) of the Figure and Shape of a Mulberry with sharp Starts sticking out around it, of a hard glassy Texture. As it was the Opinion of some, that these Starts were formed from the Particles of Lime concreted on its Surface, I with a Pin cleared away the Root of one of them, which I could trace deep into the Substance of the soft brown Matter, of which the Body of the Stone consisted; a convincing Proof that they were originally formed there; and I think it appears no less evident, that the Body of the Stone was wasted by the Lime-water, while the harder shining Points remained, in a great measure, undiminished *.

* Did not the greyish Powder obtained by evaporating the Sediment of the Urine, consist chiefly of the softer Part of the Stone dissolved by that Fluid; and were not the shining Particles in it, part of the sharp glassy Starts, washed off, or, perhaps, partly dissolved by the Urine?

ERRATA.

Pag. 4. lin. 29. for *Lymery* read *Lemery*.

Pag. 102, lin. 24. for *wheu* read *when*.

Pag. 105. lin. 29. for * read (*a*).

Pag. 164. lin. 3. after *Medicines add* proposed
for dissolving the Stone.



1894

350

1895

1896

1897

1898



